(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 523 016 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **92830363.5**

(22) Date of filing : **09.07.92**

(51) Int. Cl.[5] : **C03B 23/035**, C03B 23/03, C03B 35/20, C03B 35/24, C03B 27/044

(30) Priority : **10.07.91 IT RM910505**

(43) Date of publication of application : **13.01.93 Bulletin 93/02**

(84) Designated Contracting States : **BE DE ES FR GB LU NL**

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(54) Apparatus and process for the manufacture of sheets of glass having a complex shape, for use in motor vehicles.

(57) Apparatus and process for the manufacture of glazing of a complex form for vehicles comprising a roller heating oven, a supporting air bed in the shaping section, a shaping ring for conveying the sheet of glass in a vertical direction toward an upper shaping mold and a ring for conveying the sheet of glass horizontally toward a tempering station, the air bed being formed with frustoconical nozzles of such a size as to enable the shaping ring to pass through them so as to be placed beneath the floating plane.

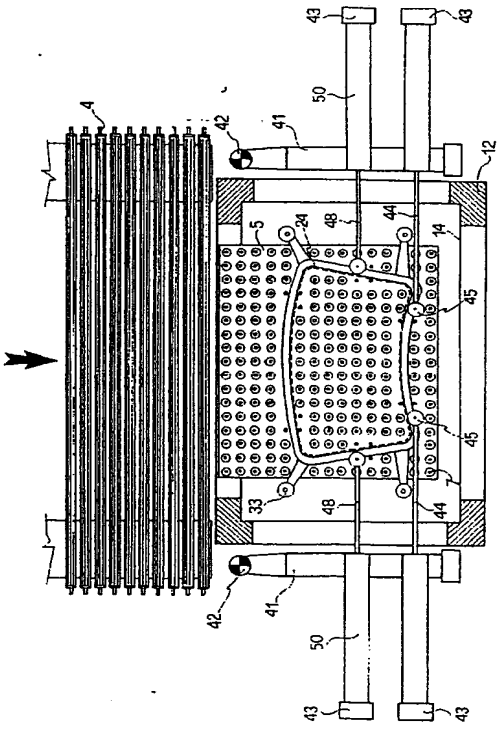

FIG 3

EP 0 523 016 A2

The present invention relates to an apparatus and process for shaping and tempering sheets of glass having a complex shape, for use as windows in vehicles.

The shape of the bodywork of a motor vehicle is of great importance, not only from an aesthetic point of view, but also from an aerodynamic one. In this context, it is also necessary that there be no surface discontinuity which would worsen the vehicle's air penetration coefficient when in movement.

For this reason glasses for automobiles in particular have taken on complex forms which can only be manufactured in specially produced plants built for the purpose.

Industrial plants for shaping and tempering sheets of glass with complex forms for use in motor vehicles are known from the state of the art.

U.S. Patent No. 4.285.715 describes a plant which heats the glass, conveyed on rollers, in a horizontal oven and, again on rollers, transports it to a shaping station; a lower, vertically mobile mold, whose flat surface is grooved so as to pass through the rollers transporting the glass, lifts the glass from said rollers and carries it upwards, until the glass is close enough to be attracted to said upper mold by means of vacuum suction; when shaping has been completed the upper mold allows the glass to drop onto a ring-like member, called a shuttle, running horizontally, which transports the glass to the tempering and cooling station.

The disadvantage in this plant lies mainly in the fact that the glass, which is at a high temperature, suffers surface deformation due to the long period of contact first with the rollers in the shaping area, and then with the flat surface of the mold; said surface deformation causes notable optical faults which are unacceptable in the case of said glass being used in motor vehicles.

U.S. Patent No. 4.508.556 describes a method and an apparatus for shaping sheets of glass having complex shapes. The sheets of glass move along an gaseous hearth bed through a horizontal heating oven, drawn by transversal bars separated by a given space, and reach the shaping station; in this area a hearth formed by a gaseous bed takes up the glass and bears it in its horizontal movement and, as said hearth has a suitable downward curve, it curves the glass by gravity into a desired shape. A hollow shaping ring, of the configuration desired, surrounds the gaseous bed and is positioned below said bed; when the whole surface of the glass is resting on the gaseous bed, the ring lifts it vertically towards a mold, to which the glass is attracted by vacuum suction, and which successively deposits the glass on a second shuttle carriage ring which carries it to the tempering and cooling station.

In this plant there are several disadvantages: first of all it is necessary to change, for production of each shape, not only the lower ring and the upper mold, but also the gaseous hearth bed, which has a curvature similar to that of the finished article; the gaseous hearth bed must also be changed in relation to the surface dimensions of the article, as it must be housed within the hollow shaping ring; furthermore the transfer from the oven to the shaping station takes place by means of intermediate rollers which, given the high temperature of the glass, can easily cause surface deformation and therefore optical defects.

The European patent application EP 415.826 describes a plant which attempts to overcome the disadvantages deriving from the presence of rollers in the curving station, substituting said rollers with a belt of suitable, heat-resistant material, placed between a lower shaping ring and an upper vacuum mold.

In this case also there are certain disadvantages, deriving mainly from the difficulties in controlling such a complex shaping system, and from the fact that prolonged standing of the glass, heated to softening temperature, on the support belt can easily cause unpleasant optical deformations.

The object of the present invention is that of providing an apparatus capable of overcoming the above mentioned disadvantages, and capable of manufacture at highly competitive production costs.

The objects of the present invention are obtained by means of an apparatus comprising: a horizontal heating furnace in which the glass is transported on rollers throughout its length; a shaping station, maintained at the same temperature as the furnace, provided with an air hearth bed to support the glass; a shaping ring which is vertically mobile and which lifts the glass from the air hearth bed towards the shaping mold; and a second hollow ring which lifts the glass from the shaping mold and conveys it horizontally towards the tempering nozzles where rapid cooling takes place.

Use of a roller conveyor in the furnace permits greater speed in heating the glass and lower plant costs, when compared with an air hearth bed used throughout the length of the furnace; in the latter case the transversal bars drawing the glass along can cause imprints on the glass itself, producing an increase in the number of rejects.

In the shaping station the rollers transporting and supporting the glass are substituted by an air bed; this bed is obtained by blowing hot air through a number of nozzles arranged in such a way as to permit uniform support of the sheet of glass and to allow the shaping ring to cross the floating level of the glass and position itself under said glass.

The term hot air is intended to mean both heated air and a mixture of air and burnt gasses, deriving for example from the combustion of methane.

The height of the nozzles is such as to allow the shaping ring, often having a large radius, to descend below the floating level; the form, number and ar-

rangement of the nozzles is such as to allow uniform support of the glass, except in correspondence with the area which is not provided with nozzles, necessary to allow the shaping ring to pass; said area is easily obtained by removing the nozzles situated therein and closing the corresponding holes with suitable threaded plugs, said nozzles having threaded cylindrical stems so that they can be screwed into the holes in a plenum.

According to a preferred embodiment of the invention the internal geometry of the nozzle, capable of allowing the passage of air in such a way as to provide suitable support to the sheet of glass, is made up of a converging channel to decrease the pressure drop caused by the inlet; a cylindrical portion with calibrated cross-section so as to obtain a substantially constant flow rate for each nozzle; a long channel with a larger diameter that the preceding cylindrical portion and preferably diverging so as to slow down the fluid stream; a final part with a frusto-conical configuration to provide final slowing of the fluid and consequently to give a flat flow of pressure at the outlet section of the nozzle.

The cylindrical portion with calibrated cross-section has preferably a diameter from 2 to 8 mm.

The diameter of the outlet section of the nozzle is preferably between 40 to 100 mm.

The supply pressure of air to the nozzles is preferably 50 millibar to 1000 millibar, and said pressure can be adjusted during the working cycle to values between said upper and lower limit in order to vary the distance between the sheet of glass and the level of the nozzles and/or to optimize the consumption of hot air, which has a temperature preferably from 600°C to 700°C.

The distance of the sheet of glass from the level of the nozzles is preferably 0,2 mm to 1 mm, and can vary during the working cycle, oscillating between said limit values according to the pressure of the air fed into the nozzles.

The nozzles are arranged on the plenum with their perpendicular axes at the vertexes of a triangular, or square, or rectangular mesh with a pitch such as to guarantee in any case adequate discharge space for the air between adjacent nozzles, to allow better support of the sheet of glass, especially in the case of nozzles with a high diameter outlet section.

In the vicinity of the areas where the shaping ring passes it may be advisable to use nozzles of smaller diameter, thus giving coexistence on the same plane of nozzles with different outlet section diameters, without producing any disturbance in the action of,supporting the sheet of glass.

The lower shaping mold is formed by a hollow ring, which has no gaps in its profile, supported by metal ties which allow the ring to perform a vertical movement from the level below the air hearth bed up to the upper mold and, later, to return below the floating level of the glass until the cycle is repeated.

The transfer ring is integral with a mold-bearing structure capable of performing a reciprocating horizontal translation to pick up the shaped glass as it is released from the upper shaping mold and to transfer it to the tempering station.

Object of the invention is therefore an apparatus for the shaping and tempering of sheets of glass having a complex shape, for use as glazing in motor vehicles, comprising a heating station formed by a horizontal furnace, a shaping station immediately following said heating furnace and provided with a lower shaping ring and with an upper shaping mold, positioned above and below with respect to the plane on which the sheets of glass move, a tempering station provided with tempering nozzles to effect the rapid cooling of said sheets of glass after shaping and with means for conveying and supporting said sheets of glass, characterized in that said means comprise, following the direction of movement of the sheets of glass: cylindrical rollers for conveying and supporting the sheets inside the heating furnace , an air hearth bed for supporting the sheets in the shaping station, and a hollow ring for transportation in the shaping station through a vertical movement towards an upper shaping mold, a hollow ring for transportation of the sheets through a reciprocating horizontal movement towards the tempering station and for support of the sheets during the tempering operation.

A further object of the invention is a process for the shaping and tempering of sheets of glass having complex forms, for use as windscreens for motor vehicles, comprising a heating step to heat the sheet of glass, a shaping step and a tempering step, characterized in that the,sheet of glass moves, during the heating step, along a cylindrical roller bed, and on an air hearth bed, immediately after leaving the furnace, then during the shaping stage on a shaping ring which conveys it vertically toward the upper shaping mold, and after shaping on a ring which conveys it horizontally to the tempering station and supports it during the tempering step.

The advantages gained by the present invention are the following: the glass can remain on a hot air bed for a fairly long time without suffering notable deformation and thus limiting optical defects, because the air flow is formed so as not to transfer heat and so as not to produce localized deformations on the surface of the glass; the air bed is flat and can therefore be used whatever the form of the sheet of glass to be curved, thus reducing, with respect to the prior art, the costs necessary for change of equipment; the same plane onto which the nozzles are screwed is used whatever the geometric form of the piece to be shaped may be; the shaping ring can cross the floating level of the sheet of glass and for this reason no gaps are required on the ring itself, as is necessary when rollers are present.

Further characteristics and advantages of the present invention will become clear from the following description, given merely as a non-limiting example with reference to the accompanying drawings, in which:

figure 1 shows an overall view of the apparatus according to the present invention;

figure 2 is a vertical cross-section view of the shaping station;

figure 3 is a top view of the glass support plane and the stops;

figure 4 is a vertical cross-section view of the device for producing the air bed;

figure 5 is a longitudinal cross-section view of the shuttle device for conveying the shaped sheet of glass from the shaping station to the tempering station;

figure 6 is a vertical cross-section view of the shaping station according to an alternative embodiment of the apparatus of the present invention.

The apparatus comprises a heating furnace 1, a shaping station 2, a tempering station 3 and a delivery station, not shown in the drawings.

According to the present invention the heating furnace 1 brings the glass up to softening temperature, conveying it along a horizontal path formed by a cylindrical roller bed 4, the movement of which is provided by means of an operating mechanism not shown in the figures.

The shaping station 2 is situated immediately after the horizontal furnace 1. The shaping station is contained within a hot chamber 12, the walls of which are built of refractory material and which is kept at a temperature of approximately 650°C with the aid of electric heating elements, not shown in the figures.

The control devices for the shaping operation are situated outside the chamber 12, whereas the equipment performing said shaping is located inside the chamber.

Following immediately the outlet from the furnace 1, on an extension of the roller conveyor for the glass, a plenum 5 is arranged within the hot chamber 12, the plenum being fed by hot air through a tube 6 and supporting a plurality of nozzles 7, arranged in a suitable size and number.

The group of nozzles 7 generates a supporting air bed which forms an extension of the glass conveyor formed by rollers 4. The air bed also has a flat surface.

A bearing frame 8 supports the plenum 5 within the hot chamber 12. The frame 8 has two hinges 9 close to the outlet from the furnace 1 and on the opposite side two mechanical jacks 10, moved by means of motor 11, which can incline the surface of the feeder plenum by 1°-2° with respect to the horizontal.

When the sheet of glass V is on the air bed, the plenum 5 inclines downward, assisting the glass to slide and giving perfect adhesion of the edge of said glass against reference stops 45.

The plenum 5, preferably made of stainless steel, has on its upper plate 51 a plurality of threaded bores 52, arranged density so as not to compromise the resistance of the plate, but at the same time allowing optimum arrangement of the nozzles according to the geometrical form of the sheet of glass to be shaped.

The nozzles 7 have a first threaded cylindrical portion 53, to allow them to be screwed into the plate 51 of the plenum 5, a second cylindrical portion 54 and a third portion 55 with a substantially frusto-conical shape, and they are preferably made of stainless steel, given that the temperature in the hot chamber of the shaping station is between 600 and 700°C.

According to a preferred embodiment of the invention the internal geometry of the nozzle, capable of allowing a suitable passage of air, is made up of a first converging channel 56, a successive cylindrical portion with calibrated cross-section 57, a cylindrical channel 58 with a larger diameter than the preceding portion, a cylindrical channel 59 with a larger diameter than the preceding channel 58 and a final frusto-conical part 60 to provide final slowing of the fluid.

The cylindrical portion 57 has preferably a diameter from 2 to 8 millimeters.

The diameter of the outlet section of the nozzle 7 is preferably 40 to 100 millimeters.

The nozzles 7 are arranged on the plenum 5 at the vertexes of a square mesh with a pitch such as to guarantee the desired air discharge space.

In the areas left without nozzles to allow passage of the shaping ring 24 the bores 52 are closed by means of threaded plugs 61.

On the side walls of the hot chamber openings are formed, said openings being necessary for maintenance and inspection purposes; furthermore an opening 13 allows the glass to enter the chamber and another opening 14 allows said glass to leave it.

To avoid heat losses, said opening 14 is provided with a drop gate 15 which opens in cycle to permit the entry and exit of a shuttle 16.

The upper shaping mold 17 is formed by a full mold 18, shaped and provided with a perforated plane, so as to produce a vacuum effect resulting in a suction of the glass V, the vacuum being produced using a Venturi system, not shown in the figure, which ejects the air sucked up through a tube 25.

The mold 17 is anchored to two support rods 19 which come out of the hot chamber 12 through passages 20 made in the refractory material of the ceiling thereof, and which are connected to a mobile frame 21, in its turn moved vertically by an operating mechanism 23 and a digitally controlled motor 22.

The vertical movement of the upper mold provides the position of the mold itself to be registered in correspondence with the shaping ring 24.

An operating mechanism made up of chains 26

and motor-winch 27 provides to lift the mobile part of the mold, so as to facilitate its extraction when changing equipment.

The hollow shaping ring 24 is supported by ties 33 so as to perform a vertical movement within the hot chamber 12 by means of an operating mechanism and a motor not shown in the figures.

The device 16 performing a reciprocating horizontal transfer of the sheet of glass to the tempering station from the shaping station, commonly known as a shuttle, has at one of its extremities a hollow ring 34 to house the sheet of glass V and support it during the quenching phase; preferably, unloading of the sheets of glass takes place in the same station, making use of a pressure differential between the upper and the lower blower, pushing the glass upward so that it leaves the ring 34, which is thus able to go back and load another sheet of glass.

A support structure 29 supports driving screws 30, to which longitudinal guides 28 with an upturned V cross-section are fixed.

Wheels 31 are engaged with the V-shaped guides and support the shuttle 16, which is made up of two independent side sections kept parallel by the engagement of the driving screws 30.

A rack guided system 35 with a parallel bar prevents oscillation during the horizontal movement.

The reciprocating horizontal movement of the mold-bearing shuttle 16 is generated by means of the driving screws 30 engaged with roller wheels 38 connected to the side sections of the shuttle itself and pressing elastically on the thread of the screws 30. The driving screws are two in number, one on each side of the machine, and they are counter-rotating and have right--and left-handed threads, respectively.

The screws 30 are supported at their ends by self-aligning roller bearings 32.

The screws 30 are activated by means of a toothed belt gear 39.

The group of stops 50 receives the glass V when it leaves the furnace, slowing said glass down progressively as it rests on the air bed formed by the nozzles 7.

Two support structures 41, one on each side of the machine, hinged at 42, support the carriages 43 which are moved by a digitally controlled motor not shown in the figures.

The stop rods 44 and 48 have, at the ends which contact the glass V, ceramic wheels 45; the rods themselves are slightly flexible, so as to adapt to the position of the plane 5 which can be inclined by 1 or 2 degrees.

The sheet of glass V is heated to its softening point in the furnace 1 as it is carried by the roller bed 4; subsequently, after leaving the roller bed, conveyed on an air hearth bed it is delivered to a first pair of rods 44 which, extending from the carriages 43, come into contact with the front edge of the sheet of glass V and slow it down, running along guides 41, situated at the side and outside the hot chamber 12, until stopping the sheet of glass in a suitable position defined by the shaping ring positioned below the floating plane.

A second pair of rods 48, extending from the carriages 43, intervenes from the sides to center and position the sheet of glass with respect to the shaping ring 24, which is situated below the floating plane.

At the moment in which the sheet of glass has been finally centered, the ring 24 rises, taking up the sheet of glass V and conveying it towards the shaping mold 18 until it is at a distance such as to allow the vacuum created by the mold by means of its perforated plane to attract the sheet of glass V, which thus continues to bend, taking on the desired shape.

In the meantime the hollow shaping ring 24 returns below the floating plane of the sheet of glass ready to repeat the cycle.

When shaping has been completed, the mold 18 releases the sheet of glass onto the ring 34 of the shuttle 16, which has positioned itself in the meantime under the mold 18, and the shuttle moves rapidly toward the tempering station 3 which contains opposite upper nozzles 46 and lower nozzles 47 that perform quenching of the shaped glass V, and which preferably also performs unloading of the glass.

After this the shuttle 16 with the ring 34 return to the shaping station 2, positioning themselves once more under the mold 18 to collect another sheet of glass to be tempered.

According to an alternative embodiment of the apparatus according to the present invention, shown in figure 6, the air hearth bed is generated by nozzles 7 fed by two separate and adjacent plenums 62 and 63, preferably of the same size with respect to the axis of symmetry of the shaping station.

The plenums rest on hinges 65 placed close to the vertical walls of the hot chamber 12 and on a single strut 64, preferably situated at the vertical axis of symmetry of the shaping station, the hinges 65 belonging to the support frame 8 which is capable of inclining in the direction of movement of the sheet of glass.

Stops 66 run on guides 67 connected to the two plenums 62 and 63.

The strut 64 rests on a bar 68 capable of being lifted by mechanical jacks 69 moved by the motor 70, and it is suitably hinged to the bar 68.

The vertical lifting movement of the strut 64, shown in the figure in its resting position, is such as to allow the two plenums and therefore the air bed to incline by 1° - 2°.

By this solution an air bed is obtained which is efficient both when producing large sheets of glass occupying a substantial part of the air bed itself, and also when producing smaller sheets of glass which are worked side-by-side in pairs.

In the latter case, in fact, the two sheets of glass are brought up against the head stops, not shown in the figure, by means of a downward inclination of the two plenums 62 and 63 in the direction of movement of the glass. The sheets of glass are then brought up to the side stops by lifting of the strut 64, which inclines the two plenums by 1° - 2° in a transversal direction with respect to the direction of movement of the glass, so as to slide the sheets against the side stops and thus position them exactly with respect to the shaping rings 24.

The advantage of this embodiment consists mainly in the fact that the manufacturing apparatus becomes capable of producing sheets of glass of varying sizes without having to change the air bed plane, thus obtaining a notable reduction in costs.

Claims

1. Apparatus for the shaping and tempering of sheets of glass (V) having a complex shape, for use as glazing in motor vehicles, comprising a heating station formed by a horizontal furnace (1), a shaping station (2) immediately following said heating furnace and provided with a lower shaping ring and with an upper shaping mold, (17) positioned above and below with respect to the plane on which the sheets of glass move, a tempering station (3) provided with tempering nozzles (7) to effect the rapid cooling of said sheets of glass after shaping and with means for conveying and supporting said sheets of glass, characterized in that said means comprise, following the direction of movement of the sheets of glass: cylindrical rollers (4) for conveying and supporting the sheets inside the heating furnace (1), an air hearth bed for supporting the sheets in the shaping station, and a hollow ring (24) for transportation in the shaping station through a vertical movement towards an upper shaping mold (18), a hollow ring (24) for transportation of the sheets through a reciprocating horizontal movement towards the tempering station and for support of the sheets during the tempering operation.

2. Apparatus as claimed in claim 1, in which the profile of the hollow ring (24) on which the edge of the sheet of glass rests is a continuous profile with no gaps.

3. Apparatus as claimed in claim 1 or 2, in which the air hearth bed in the shaping station begins immediately after the outlet section-of the heating furnace.

4. Apparatus as claimed in any one of the preceding claims, in which the air hearth bed has a flat supporting surface.

5. Apparatus as claimed in any one of the preceding claims, comprising a support frame (8) supporting a plenum (5), said plenum feeding the nozzles (7) to generate the air hearth bed in the shaping station, characterized in that said nozzles (7) are higher than the radius of the ring (24) to allow said ring to be housed below the floating level of the sheet of glass.

6. Apparatus as claimed in any one of the preceding claims, in which the nozzles (7) have a calibrated cross-section (57) with a diameter preferably from 2 to 8 millimeters.

7. Apparatus as claimed in any one of the preceding claims, in which the nozzles (7) have an outlet section with a diameter preferably from 40 to 100 millimeters.

8. Apparatus as claimed in any one of the preceding claims, in which the supply pressure of the air fed to the nozzles (7) is preferably from 50 millibar to 1000 millibar.

9. Apparatus as claimed in any one of the preceding claims, further comprising stops (45) in the shaping station, characterized in that the support frame (8) of the plenum (5) feeding the nozzles (7) has at its bearing points respective hinges (9) and jack pistons (10) so as to allow a downward inclination of the air bed, in the direction of movement of the sheet of glass, to ensure that the edge of the sheet of glass itself rests perfectly against said stops (45).

10. Apparatus as claimed in any one of the preceding claims, in which the shaping ring (24) is suspended on vertical ties (33) so as to perform a vertical movement of a length such as to bring it up to the upper shaping mold (18) until it is close enough for the sheet of glass to be attracted to said mold by vacuum.

11. Apparatus as claimed in any one of the preceding claims, characterized by a stop device comprising two pairs of elements to stop the sheet of glass, a first pair being formed by rods (44) which extend from cylinders (43) until their ends (45) come into contact with the front edge of the sheet of glass and slow it down, said rods (44) moving along guides (41) parallel to the outer sides of the hot chamber (12), to stop said sheet of glass in a position defined by the shaping ring (24), and a second pair being formed by rods (48) which extend to come into contact with the side edges of

the sheet of glass to center it in a position defined by the shaping ring (24) positioned under the floating plane of the sheet of glass.

12. Apparatus as claimed in any one of the preceding claims, comprising nozzles (7) to produce said air hearth bed, two plenums (62) and (63) separated in correspondence with the vertical axis of symmetry of the shaping station and adjacent one to the other, said plenums feeding said nozzles, a vertically mobile strut (64) arranged on the vertical axis of symmetry of the shaping station and hinges (65) arranged at the sides thereof to support said plenums, said plenums being capable of inclination in a transversal direction with respect to the direction of movement of the sheets of glass, so as to perform.a perfect positioning of a pair of sheets of glass being processed together.

13. Process for the shaping and tempering of sheets of glass having complex forms, for use as windscreens for motor vehicles, comprising a heating step to heat the sheet of glass, a shaping step and a tempering step, characterized in that the sheet of glass moves, during the heating step, along a cylindrical roller bed, and on an air hearth bed, immediately after leaving the furnace, then during the shaping stage on a shaping ring which conveys it vertically toward the upper shaping mold, and after shaping on a ring which conveys it horizontally to the tempering station and supports it during the tempering step.

14. Process as claimed in claim 13, in which the sheet of glass in the shaping station is lifted vertically by the air hearth bed supporting it until it is at a distance from the upper shaping mold such that it can be attracted to said mold by vacuum, and in that after shaping said sheet of glass is released onto a second shuttle ring which conveys it to the tempering station.

15. Process as claimed in claims 13 and 14, in which the shaping ring returns to the shaping station after the shaping operation and positions itself below the air bed floating plane to wait until the working cycle is repeated.

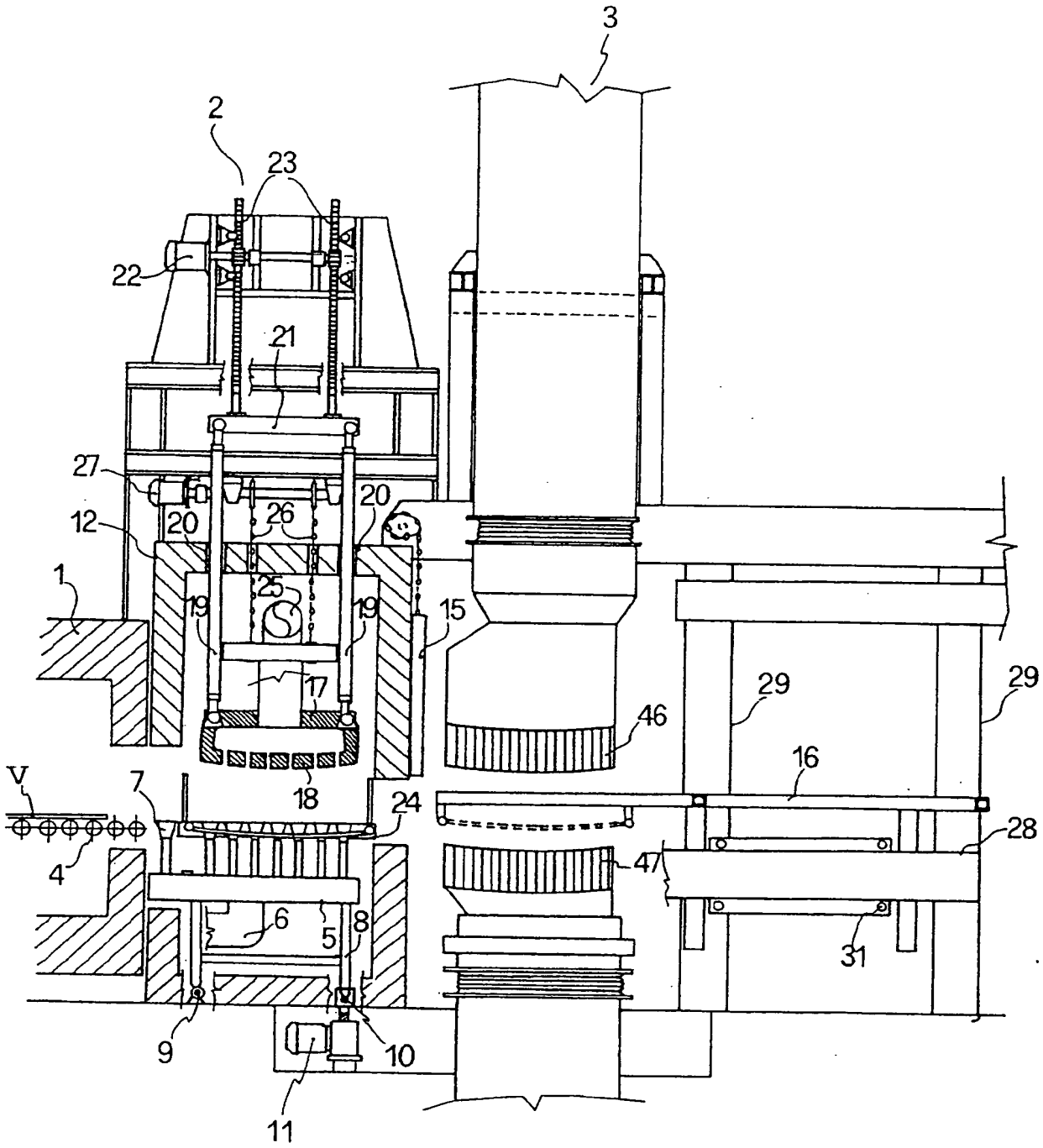

FIG 1

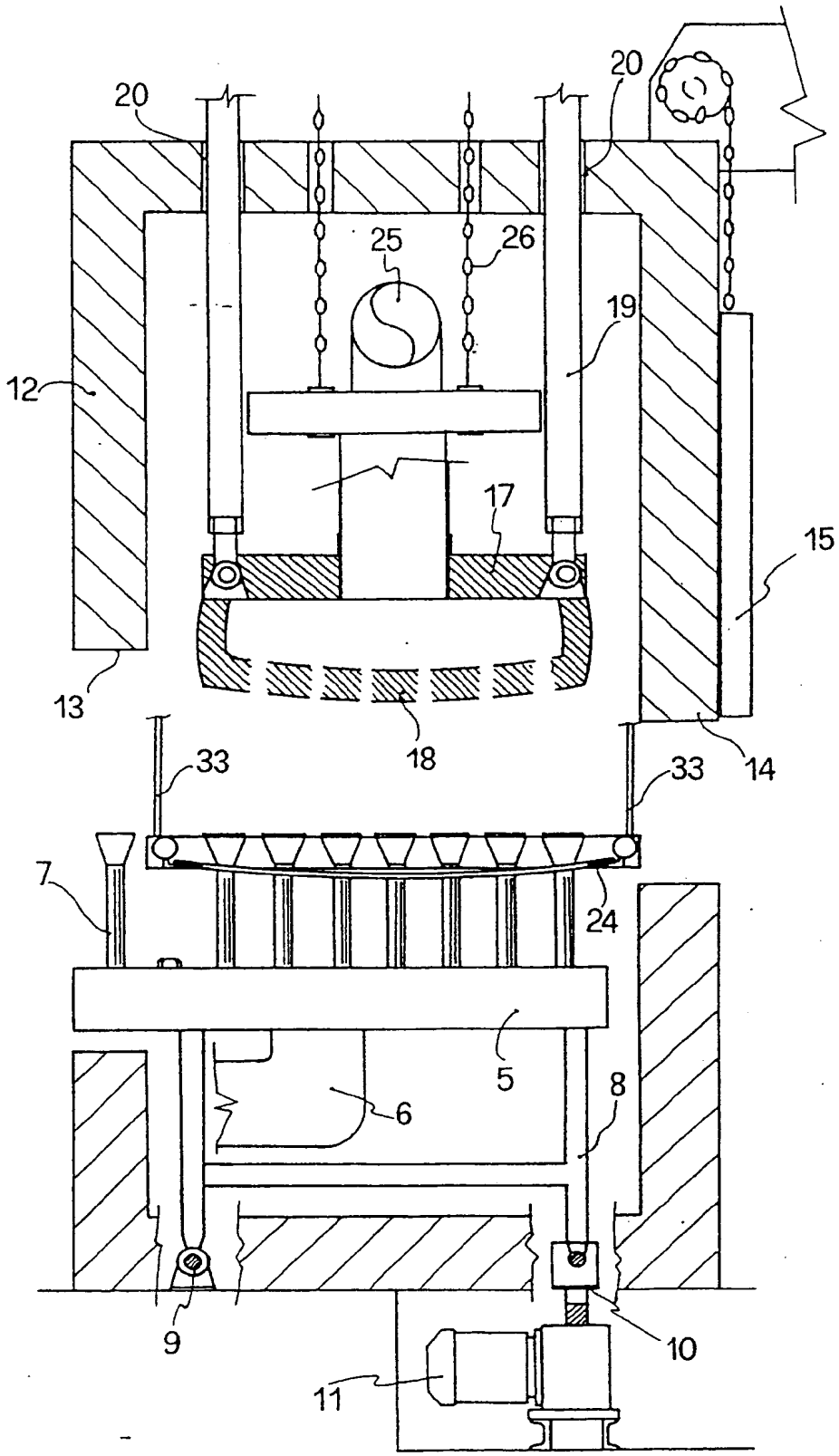

FIG 2

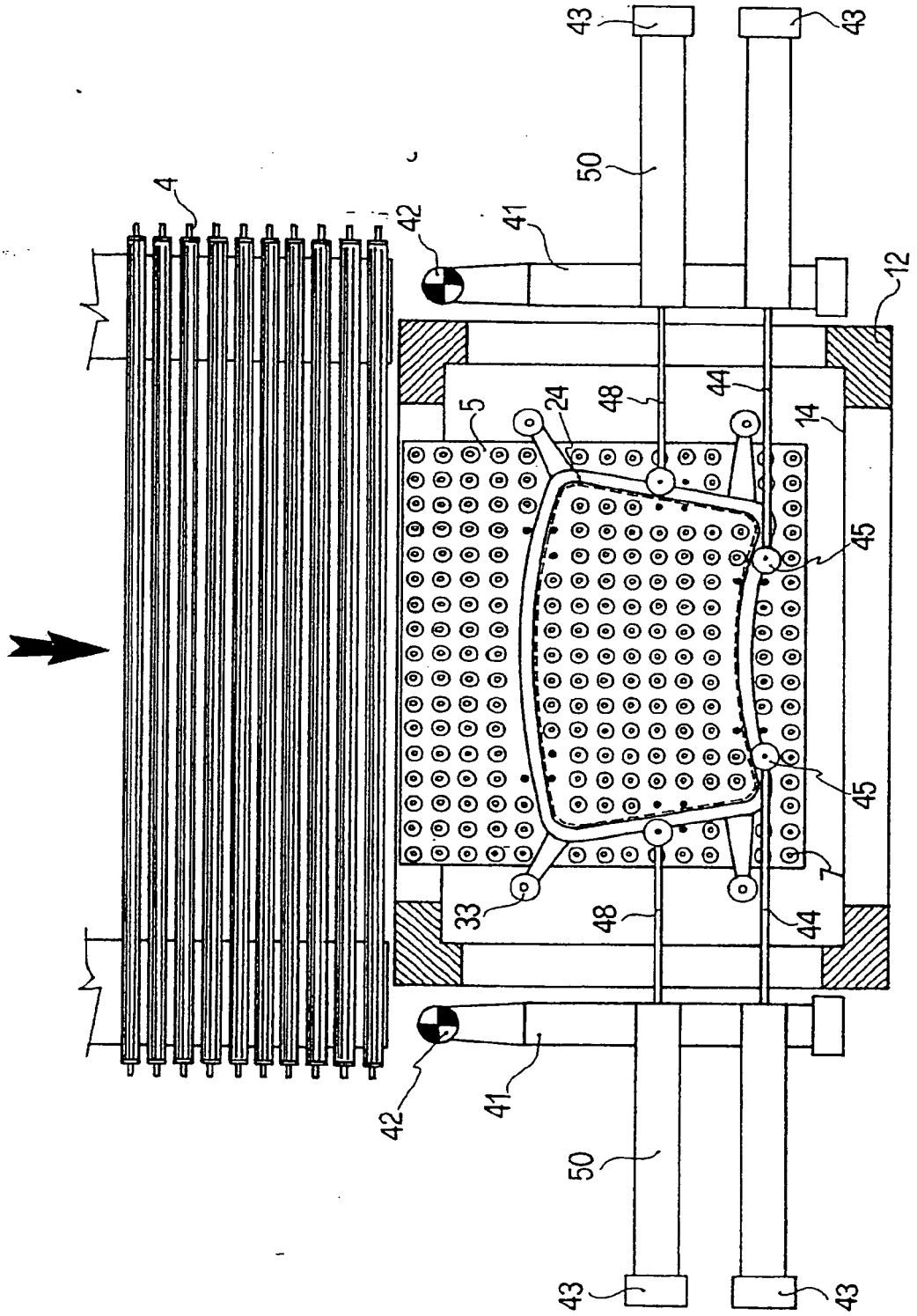

FIG 3

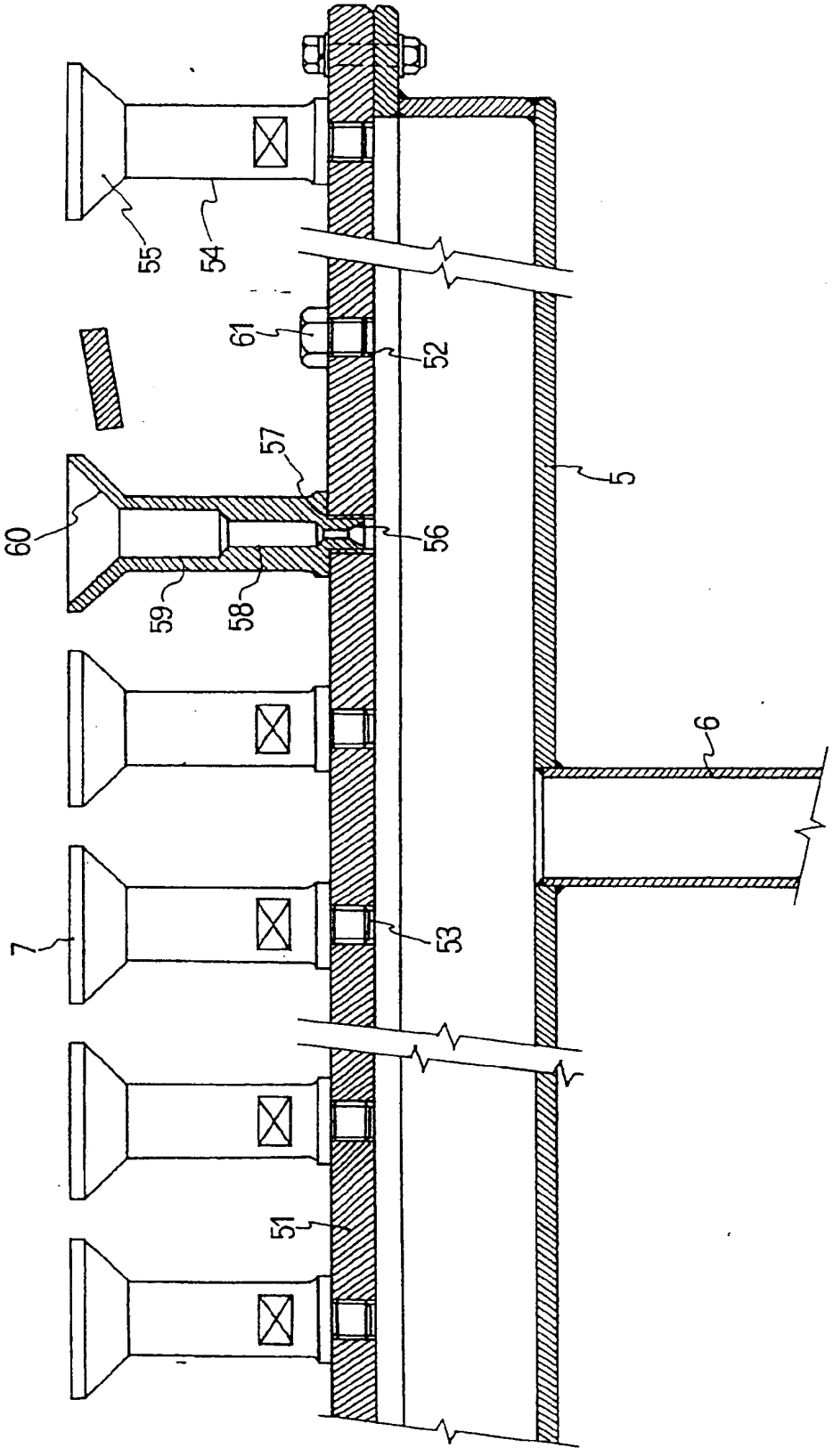

FIG 4

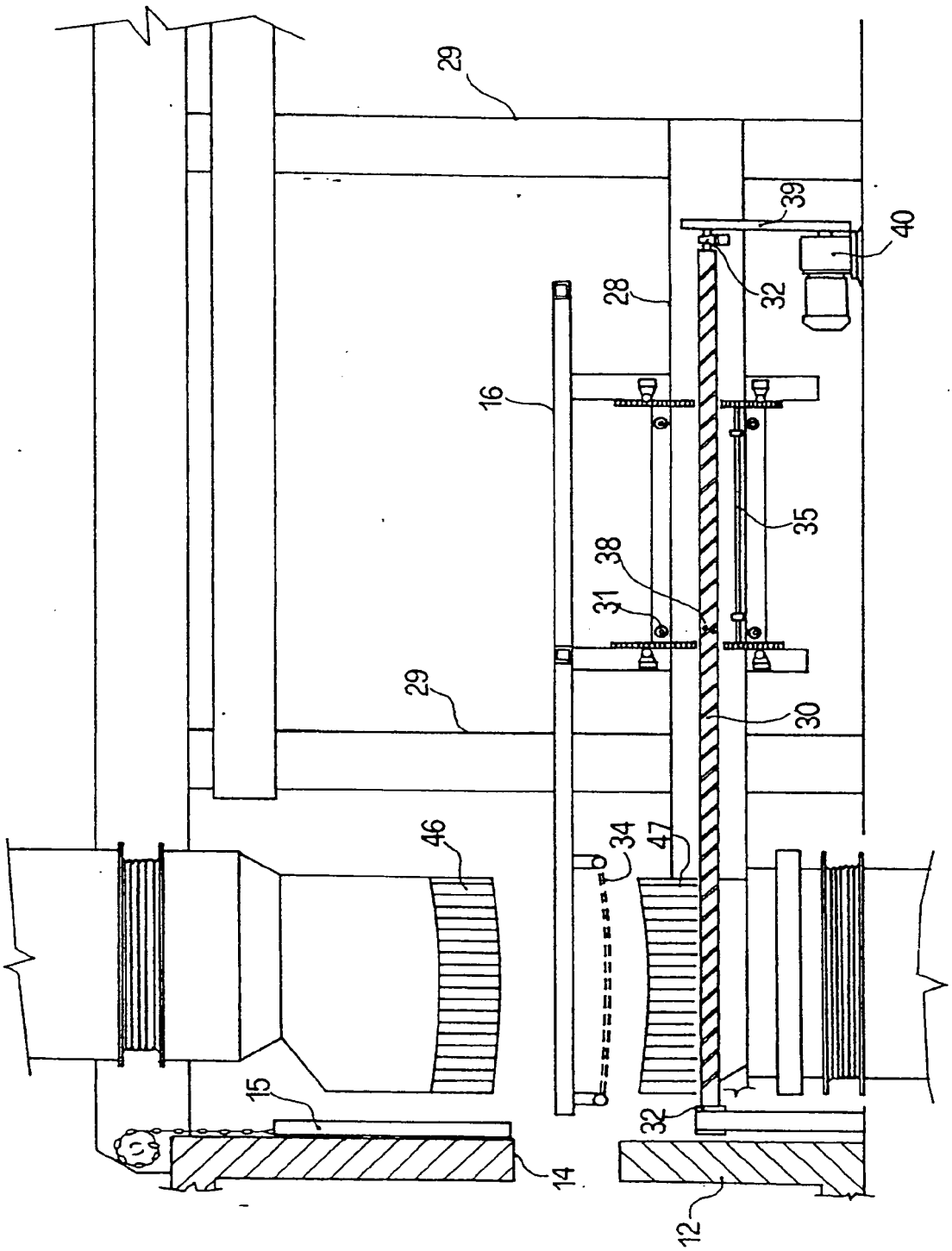

FIG 5

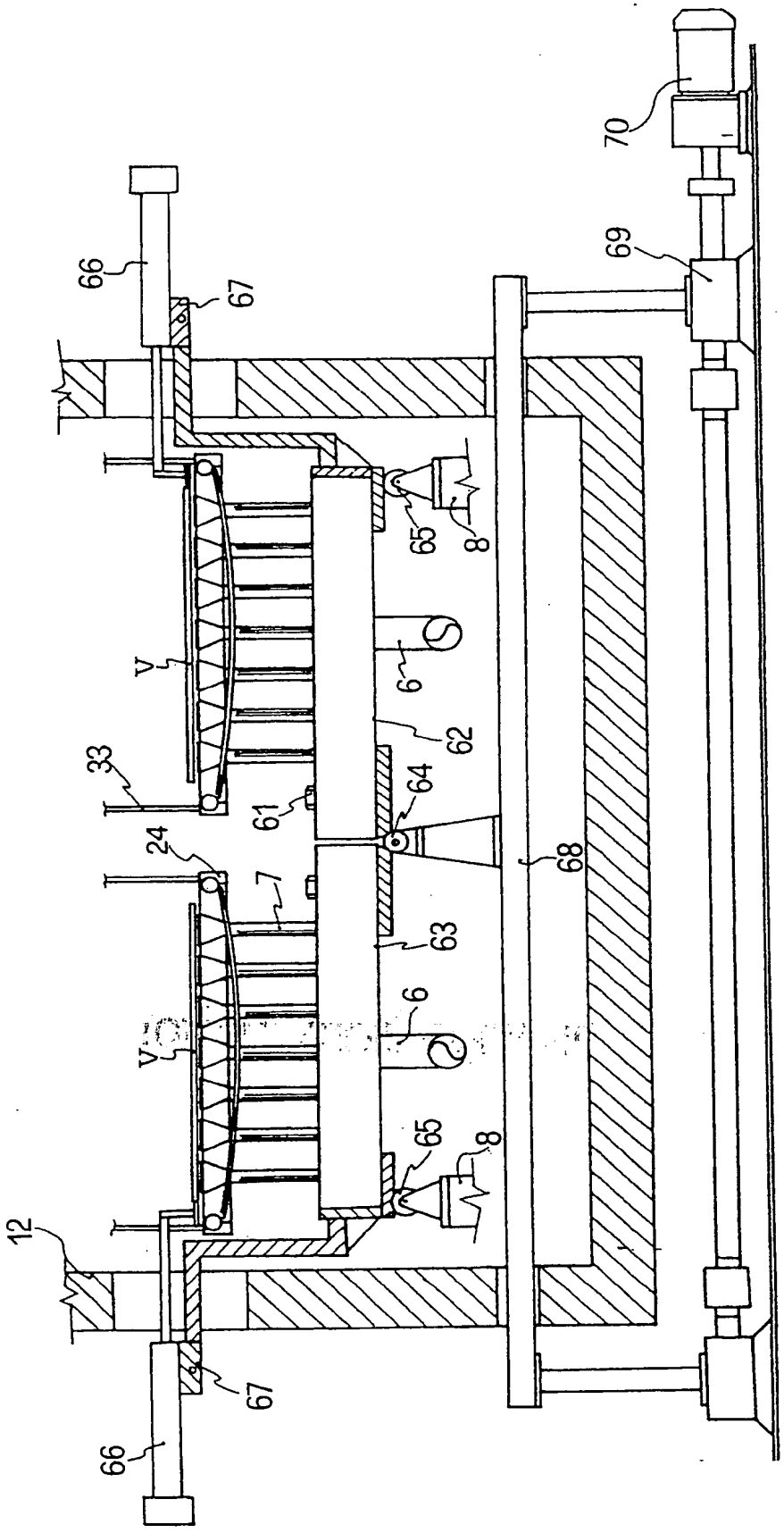

FIG 6

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 523 016 A3**

(12) EUROPEAN PATENT APPLICATION

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(30) Priority : **10.07.91 IT RM910505**

(43) Date of publication of application : **13.01.93 Bulletin 93/02**

(84) Designated Contracting States : **BE DE ES FR GB LU NL**

(88) Date of deferred publication of search report : **25.08.93 Bulletin 93/34**

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(54) Apparatus and process for the manufacture of sheets of glass having a complex shape, for use in motor vehicles.

(57) Apparatus and process for the manufacture of glazing of a complex form for vehicles comprising a roller heating oven (1), a supporting air bed (7) in the shaping section (2), a shaping ring (24) for conveying the sheet of glass in a vertical direction toward an upper shaping mold (17) and a ring (34) for conveying the sheet of glass (V) horizontally toward a tempering station (3), the air bed (7) being formed with frustoconical nozzles of such a size as to enable the shaping ring (24) to pass through them so as to be placed beneath the floating plane.

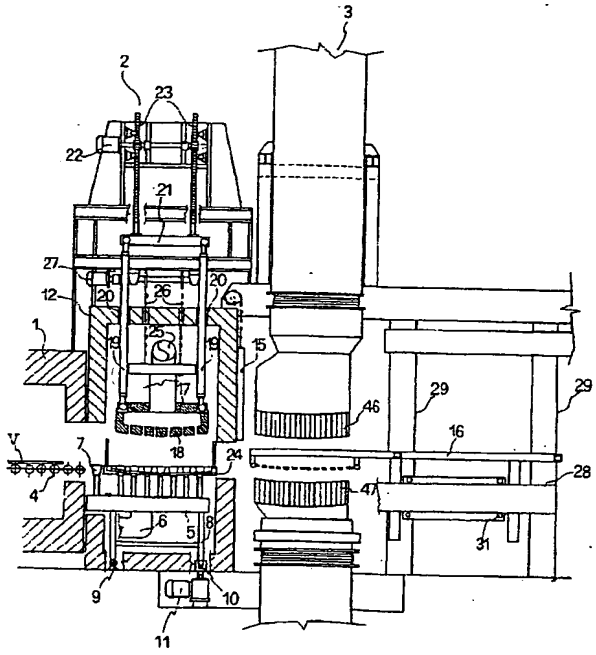

FIG 1

EP 0 523 016 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number EP 92 83 0363

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-4 508 556 (BENNETT) * the whole document *	1-4,9,13	C03B23/035 C03B23/03 C03B35/20 C03B35/24 C03B27/044 C03B35/14
X	DE-A-2 400 296 (PPG INDUSTRIES,INC.) * the whole document *	1-15	
X	US-A-4 204 853 (SEYMOUR) * the whole document *	1-4,9, 11,13	
X	US-A-3 468 645 (MCMASTER) * the whole document *	1-4	
X	US-A-3 869 271 (SHAFFER) * the whole document *	1-4,13	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	03 JUNE 1993	VAN DEN BOSSCHE W.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EPO FORM 1503 03.82 (P0601)

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 523 016 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
22.01.1997 Bulletin 1997/04

(51) Int. Cl.[6]: **C03B 23/035**, C03B 23/03, C03B 35/20, C03B 35/24, C03B 27/044, C03B 35/14

(21) Application number: **92830363.5**

(22) Date of filing: **09.07.1992**

(54) Apparatus for the manufacture of sheets of glass having a complex shape, for use in motor vehicles

Vorrichtung zum Herstellen von Glasscheiben mit komplexer Form zum Gebrauch in Motorfahrzeugen

Appareil pour la fabrication de feuilles de verre ayant une forme complexe, à utilisation dans des véhicules moteur

(84) Designated Contracting States:
BE DE ES FR GB LU NL

(30) Priority: **10.07.1991 IT RM910505**

(43) Date of publication of application:
13.01.1993 Bulletin 1993/02

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Description

The present invention relates to an apparatus and process for shaping and tempering sheets of glass having a complex shape, for use as windows in vehicles.

The shape of the bodywork of a motor vehicle is of great importance, not only from an aesthetic point of view, but also from an aerodynamic one. In this context, it is also necessary that there be no surface discontinuity which would worsen the vehicle's air penetration coefficient when in movement.

For this reason glasses for automobiles in particular have taken on complex forms which can only be manufactured in specially produced plants built for the purpose.

Industrial plants for shaping and tempering sheets of glass with complex forms for use in motor vehicles are known from the state of the art.

U.S. Patent No. 4.285.715 describes a plant which heats the glass, conveyed on rollers, in a horizontal oven and, again on rollers, transports it to a shaping station; a lower, vertically mobile mold, whose flat surface is grooved so as to pass through the rollers transporting the glass, lifts the glass from said rollers and carries it upwards, until the glass is close enough to be attracted to said upper mold by means of vacuum suction; when shaping has been completed the upper mold allows the glass to drop onto a ring-like member, called a shuttle, running horizontally, which transports the glass to the tempering and cooling station.

The disadvantage in this plant lies mainly in the fact that the glass, which is at a high temperature, suffers surface deformation due to the long period of contact first with the rollers in the shaping area, and then with the flat surface of the mold; said surface deformation causes notable optical faults which are unacceptable in the case of said glass being used in motor vehicles.

U.S. Patent No. 4.508.556 describes a method and an apparatus for shaping sheets of glass having complex shapes. The sheets of glass move along an gaseous hearth bed through a horizontal heating oven, drawn by transversal bars separated by a given space, and reach the shaping station; in this area a hearth formed by a gaseous bed takes up the glass and bears it in its horizontal movement and, as said hearth has a suitable downward curve, it curves the glass by gravity into a desired shape. A hollow shaping ring, of the configuration desired, surrounds the gaseous bed and is positioned below said bed; when the whole surface of the glass is resting on the gaseous bed, the ring lifts it vertically towards a mold, to which the glass is attracted by vacuum suction, and which successively deposits the glass on a second shuttle carriage ring which carries it to the tempering and cooling station.

In this plant there are several disadvantages: first of all it is necessary to change, for production of each shape, not only the lower ring and the upper mold, but also the gaseous hearth bed, which has a curvature similar to that of the finished article; the gaseous hearth bed must also be changed in relation to the surface dimensions of the article, as it must be housed within the hollow shaping ring; furthermore the transfer from the oven to the shaping station takes place by means of intermediate rollers which, given the high temperature of the glass, can easily cause surface deformation and therefore optical defects.

The European patent publication EP-A-0.415.826 describes a plant which attempts to overcome the disadvantages deriving from the presence of rollers in the curving station, substituting said rollers with a belt of suitable, heat-resistant material, placed between a lower shaping ring and an upper vacuum mold.

In this case also there are certain disadvantages, deriving mainly from the difficulties in controlling such a complex shaping system, and from the fact that prolonged standing of the glass, heated to softening temperature, on the support belt can easily cause unpleasant optical deformations.

The object of the present invention is that of providing an apparatus capable of overcoming the above mentioned disadvantages, and capable of manufacture at highly competitive production costs.

The objects of the present invention are obtained by means of an apparatus comprising: a horizontal heating furnace in which the glass is transported on rollers throughout its length; a shaping station, maintained at the same temperature as the furnace, provided with an air hearth bed to support the glass; a shaping ring which is vertically mobile and which lifts the glass from the air hearth bed towards the shaping mold; and a second hollow ring which lifts the glass from the shaping mold and conveys it horizontally towards the tempering nozzles where rapid cooling takes place.

Use of a roller conveyor in the furnace permits greater speed in heating the glass and lower plant costs, when compared with an air hearth bed used throughout the length of the furnace; in the latter case the transversal bars drawing the glass along can cause imprints on the glass itself, producing an increase in the number of rejects.

In the shaping station the rollers transporting and supporting the glass are substituted by an air bed; this bed is obtained by blowing hot air through a number of nozzles arranged in such a way as to permit uniform support of the sheet of glass and to allow the shaping ring to cross the floating level of the glass and position itself under said glass.

The term hot air is intended to mean both heated air and a mixture of air and burnt gasses, deriving for example from the combustion of methane.

The height of the nozzles is such as to allow the shaping ring, often having a large radius, to descend below the floating level; the form, number and arrangement of the nozzles is such as to allow uniform support of the glass, except in correspondence with the area which is not provided with nozzles, necessary to allow the shaping ring to pass; said area is easily obtained by removing the nozzles situated therein and closing the

corresponding holes with suitable threaded plugs, said nozzles having threaded cylindrical stems so that they can be screwed into the holes in a plenum.

According to a preferred embodiment of the invention the internal geometry of the nozzle, capable of allowing the passage of air in such a way as to provide suitable support to the sheet of glass, is made up of a converging channel to decrease the pressure drop caused by the inlet; a cylindrical portion with calibrated cross-section so as to obtain a substantially constant flow rate for each nozzle; a long channel with a larger diameter that the preceding cylindrical portion and preferably diverging so as to slow down the fluid stream; a final part with a frusto-conical configuration to provide final slowing of the fluid and consequently to give a flat flow of pressure at the outlet section of the nozzle.

The cylindrical portion with calibrated cross-section has preferably a diameter from 2 to 8 mm.

The diameter of the outlet section of the nozzle is preferably between 40 to 100 mm.

The supply pressure of air to the nozzles is preferably 50 millibar to 1000 millibar, and said pressure can be adjusted during the working cycle to values between said upper and lower limit in order to vary the distance between the sheet of glass and the level of the nozzles and/or to optimize the consumption of hot air, which has a temperature preferably from 600°C to 700°C.

The distance of the sheet of glass from the level of the nozzles is preferably 0,2 mm to 1 mm, and can vary during the working cycle, oscillating between said limit values according to the pressure of the air fed into the nozzles.

The nozzles are arranged on the plenum with their perpendicular axes at the vertexes of a triangular, or square, or rectangular mesh with a pitch such as to guarantee in any case adequate discharge space for the air between adjacent nozzles, to allow better support of the sheet of glass, especially in the case of nozzles with a high diameter outlet section.

In the vicinity of the areas where the shaping ring passes it may be advisable to use nozzles of smaller diameter, thus giving coexistence on the same plane of nozzles with different outlet section diameters, without producing any disturbance in the action of supporting the sheet of glass.

The lower shaping mold is formed by a hollow ring, which has no gaps in its profile, supported by metal ties which allow the ring to perform a vertical movement from the level below the air hearth bed up to the upper mold and, later, to return below the floating level of the glass until the cycle is repeated.

The transfer ring is integral with a mold-bearing structure capable of performing a reciprocating horizontal translation to pick up the shaped glass as it is released from the upper shaping mold and to transfer it to the tempering station.

Object of the invention is therefore an apparatus for shaping and tempering a glass sheet for use in a motor vehicle, comprising a heating station including a horizontal furnace, a shaping station positioned downstream of said heating station including an air bed means and an upper shaping mold having a perforated shaping surface and a vacuum means for creating suction through said perforated shaping surface to attract the glass sheet thereto, a tempering station positioned downstream of said shaping station and including tempering nozzle means for rapidly cooling the glass sheet, a first glass supporting ring for supporting the glass sheet, said glass supporting ring being movable vertically from a position below said air bed means; ring moving means for moving said glass supporting ring vertically toward said perforated shaping surface of said upper shaping mold and for moving said glass supporting ring horizontally from said shaping station toward said tempering station, characterised in that it comprises a roller conveyor extending horizontally through said furnace for feeding the glass sheet in a downstream direction through said furnace along a predetermined path; said shaping station including said bed means in a position immediately adjacent to said roller conveyor and having a supporting surface of flat configuration for supporting the glass sheet at a floating level on said air bed; said first glass supporting ring being mounted in said shaping station for vertical movement between a lowered position below said floating level and a raised position closer to said perforated shaping surface of said upper shaping mold relative to said lowered position; a second glass supporting ring for supporting the glass sheet; ring moving means for moving said second glass supporting ring horizontally from said shaping station toward said tempering station; and said air bed means comprise an air plenum and a plurality of upwardly directed air nozzles individually removable supported by said plenum and in fluid communication with said plenum to allow air to be supplied through said nozzles from said plenum to form said air bed, said plenum having a ring-shaped area devoid of said nozzles, said ring shaped area corresponding to a shape of said glass supporting ring to be positioned in said ring-shaped area below said floating level, and said air nozzles being higher than the thickness and/or the radius of curvature of said glass supporting ring to allow said ring to be positioned below said floating level of said air bed.

The advantages gained by the present invention are the following: the glass can remain on a hot air bed for a fairly long time without suffering notable deformation and thus limiting optical defects, because the air flow is formed so as not to transfer heat and so as not to produce localized deformations on the surface of the glass; the air bed is flat and can therefore be used whatever the form of the sheet of glass to be curved, thus reducing, with respect to the prior art, the costs necessary for change of equipment; the same plane onto which the nozzles are screwed is used whatever the geometric form of the piece to be shaped may be; the shaping ring can cross the floating level of the sheet of glass and for this reason no gaps are required on the

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ring itself, as is necessary when rollers are present.

Further characteristics and advantages of the present invention will become clear from the following description, given merely as a non-limiting example with reference to the accompanying drawings, in which:

figure 1 shows an overall view of the apparatus according to the present invention;
figure 2 is a vertical cross-section view of the shaping station;
figure 3 is a top view of the glass support plane and the stops;
figure 4 is a vertical cross-section view of the device for producing the air bed;
figure 5 is a longitudinal cross-section view of the shuttle device for conveying the shaped sheet of glass from the shaping station to the tempering station;
figure 6 is a vertical cross-section view of the shaping station according to an alternative embodiment of the apparatus of the present invention.

The apparatus comprises a heating furnace 1, a shaping station 2, a tempering station 3 and a delivery station, not shown in the drawings.

According to the present invention the heating furnace 1 brings the glass up to softening temperature, conveying it along a horizontal path formed by a cylindrical roller bed 4, the movement of which is provided by means of an operating mechanism not shown in the figures.

The shaping station 2 is situated immediately after the horizontal furnace 1. The shaping station is contained within a hot chamber 12, the walls of which are built of refractory material and which is kept at a temperature of approximately 650°C with the aid of electric heating elements, not shown in the figures.

The control devices for the shaping operation are situated outside the chamber 12, whereas the equipment performing said shaping is located inside the chamber.

Following immediately the outlet from the furnace 1, on an extension of the roller conveyor for the glass, a plenum 5 is arranged within the hot chamber 12, the plenum being fed by hot air through a tube 6 and supporting a plurality of nozzles 7, arranged in a suitable size and number.

The group of nozzles 7 generates a supporting air bed which forms an extension of the glass conveyor formed by rollers 4. The air bed also has a flat surface.

A bearing frame 8 supports the plenum 5 within the hot chamber 12. The frame 8 has two hinges 9 close to the outlet from the furnace 1 and on the opposite side two mechanical jacks 10, moved by means of motor 11, which can incline the surface of the feeder plenum by 1°-2° with respect to the horizontal.

When the sheet of glass V is on the air bed, the plenum 5 inclines downward, assisting the glass to slide and giving perfect adhesion of the edge of said glass against reference stops 45.

The plenum 5, preferably made of stainless steel, has on its upper plate 51 a plurality of threaded bores 52, arranged density so as not to compromise the resistance of the plate, but at the same time allowing optimum arrangement of the nozzles according to the geometrical form of the sheet of glass to be shaped.

The nozzles 7 have a first threaded cylindrical portion 53, to allow them to be screwed into the plate 51 of the plenum 5, a second cylindrical portion 54 and a third portion 55 with a substantially frusto-conical shape, and they are preferably made of stainless steel, given that the temperature in the hot chamber of the shaping station is between 600 and 700°C.

According to a preferred embodiment of the invention the internal geometry of the nozzle, capable of allowing a suitable passage of air, is made up of a first converging channel 56, a successive cylindrical portion with calibrated cross-section 57, a cylindrical channel 58 with a larger diameter than the preceding portion, a cylindrical channel 59 with a larger diameter than the preceding channel 58 and a final frusto-conical part 60 to provide final slowing of the fluid.

The cylindrical portion 57 has preferably a diameter from 2 to 8 millimeters.

The diameter of the outlet section of the nozzle 7 is preferably 40 to 100 millimeters.

The nozzles 7 are arranged on the plenum 5 at the vertexes of a square mesh with a pitch such as to guarantee the desired air discharge space.

In the areas left without nozzles to allow passage of the shaping ring 24 the bores 52 are closed by means of threaded plugs 61.

On the side walls of the hot chamber openings are formed, said openings being necessary for maintenance and inspection purposes; furthermore an opening 13 allows the glass to enter the chamber and another opening 14 allows said glass to leave it.

To avoid heat losses, said opening 14 is provided with a drop gate 15 which opens in cycle to permit the entry and exit of a shuttle 16.

The upper shaping mold 17 is formed by a full mold 18, shaped and provided with a perforated plane, so as to produce a vacuum effect resulting in a suction of the glass V, the vacuum being produced using a Venturi system, not shown in the figure, which ejects the air sucked up through a tube 25.

The mold 17 is anchored to two support rods 19 which come out of the hot chamber 12 through passages 20 made in the refractory material of the ceiling thereof, and which are connected to a mobile frame 21, in its turn moved vertically by an operating mechanism 23 and a digitally controlled motor 22.

The vertical movement of the upper mold provides the position of the mold itself to be registered in correspondence with the shaping ring 24.

An operating mechanism made up of chains 26 and motor-winch 27 provides to lift the mobile part of the mold, so as to facilitate its extraction when changing

equipment.

The hollow shaping ring 24 is supported by ties 33 so as to perform a vertical movement within the hot chamber 12 by means of an operating mechanism and a motor not shown in the figures.

The device 16 performing a reciprocating horizontal transfer of the sheet of glass to the tempering station from the shaping station, commonly known as a shuttle, has at one of its extremities a hollow ring 34 to house the sheet of glass V and support it during the quenching phase; preferably, unloading of the sheets of glass takes place in the same station, making use of a pressure differential between the upper and the lower blower, pushing the glass upward so that it leaves the ring 34, which is thus able to go back and load another sheet of glass.

A support structure 29 supports driving screws 30, to which longitudinal guides 28 with an upturned V cross-section are fixed.

Wheels 31 are engaged with the V-shaped guides and support the shuttle 16, which is made up of two independent side sections kept parallel by the engagement of the driving screws 30.

A rack guided system 35 with a parallel bar prevents oscillation during the horizontal movement.

The reciprocating horizontal movement of the mold-bearing shuttle 16 is generated by means of the driving screws 30 engaged with roller wheels 38 connected to the side sections of the shuttle itself and pressing elastically on the thread of the screws 30. The driving screws are two in number, one on each side of the machine, and they are counter-rotating and have right- and left-handed threads, respectively.

The screws 30 are supported at their ends by self-aligning roller bearings 32.

The screws 30 are activated by means of a toothed belt gear 39.

The group of stops 50 receives the glass V when it leaves the furnace, slowing said glass down progressively as it rests on the air bed formed by the nozzles 7.

Two support structures 41, one on each side of the machine, hinged at 42, support the carriages 43 which are moved by a digitally controlled motor not shown in the figures.

The stop rods 44 and 48 have, at the ends which contact the glass V, ceramic wheels 45; the rods themselves are slightly flexible, so as to adapt to the position of the plane 5 which can be inclined by 1 or 2 degrees.

The sheet of glass V is heated to its softening point in the furnace 1 as it is carried by the roller bed 4; subsequently, after leaving the roller bed, conveyed on an air hearth bed it is delivered to a first pair of rods 44 which, extending from the carriages 43, come into contact with the front edge of the sheet of glass V and slow it down, running along guides 41, situated at the side and outside the hot chamber 12, until stopping the sheet of glass in a suitable position defined by the shaping ring positioned below the floating plane.

A second pair of rods 48, extending from the carriages 43, intervenes from the sides to center and position the sheet of glass with respect to the shaping ring 24, which is situated below the floating plane.

At the moment in which the sheet of glass has been finally centered, the ring 24 rises, taking up the sheet of glass V and conveying it towards the shaping mold 18 until it is at a distance such as to allow the vacuum created by the mold by means of its perforated plane to attract the sheet of glass V, which thus continues to bend, taking on the desired shape.

In the meantime the hollow shaping ring 24 returns below the floating plane of the sheet of glass ready to repeat the cycle.

When shaping has been completed, the mold 18 releases the sheet of glass onto the ring 34 of the shuttle 16, which has positioned itself in the meantime under the mold 18, and the shuttle moves rapidly toward the tempering station 3 which contains opposite upper nozzles 46 and lower nozzles 47 that perform quenching of the shaped glass V, and which preferably also performs unloading of the glass.

After this the shuttle 16 with the ring 34 return to the shaping station 2, positioning themselves once more under the mold 18 to collect another sheet of glass to be tempered.

According to an alternative embodiment of the apparatus according to the present invention, shown in figure 6, the air hearth bed is generated by nozzles 7 fed by two separate and adjacent plenums 62 and 63, preferably of the same size with respect to the axis of symmetry of the shaping station.

The plenums rest on hinges 65 placed close to the vertical walls of the hot chamber 12 and on a single strut 64, preferably situated at the vertical axis of symmetry of the shaping station, the hinges 65 belonging to the support frame 8 which is capable of inclining in the direction of movement of the sheet of glass.

Stops 66 run on guides 67 connected to the two plenums 62 and 63.

The strut 64 rests on a bar 68 capable of being lifted by mechanical jacks 69 moved by the motor 70, and it is suitably hinged to the bar 68.

The vertical lifting movement of the strut 64, shown in the figure in its resting position, is such as to allow the two plenums and therefore the air bed to incline by 1° - 2°.

By this solution an air bed is obtained which is efficient both when producing large sheets of glass occupying a substantial part of the air bed itself, and also when producing smaller sheets of glass which are worked side-by-side in pairs.

In the latter case, in fact, the two sheets of glass are brought up against the head stops, not shown in the figure, by means of a downward inclination of the two plenums 62 and 63 in the direction of movement of the glass. The sheets of glass are then brought up to the side stops by lifting of the strut 64, which inclines the two plenums by 1° - 2° in a transversal direction with respect to the direction of movement of the glass, so as to slide the sheets against the side stops and thus posi-

tion them exactly with respect to the shaping rings 24.

The advantage of this embodiment consists mainly in the fact that the manufacturing apparatus becomes capable of producing sheets of glass of varying sizes without having to change the air bed plane, thus obtaining a notable reduction in costs.

Claims

1. An apparatus for shaping and tempering a glass sheet (V) for use in a motor vehicle, comprising

   a heating station including a horizontal furnace (1),
   a shaping station (2) positioned downstream of said heating station including an air bed means and an upper shaping mold (17) having a perforated shaping surface and a vacuum means for creating suction through said perforated shaping surface to attract the glass sheet thereto,
   a tempering station (3) positioned downstream of said shaping station and including tempering nozzle means for rapidly cooling the glass sheet,
   a first glass supporting ring (24) for supporting the glass sheet, said glass supporting ring (24) being movable vertically from a position below said air bed means;
   ring moving means (16) for moving said glass supporting ring vertically toward said perforated shaping surface of said upper shaping mold and for moving said glass suppporting ring horizontally from said shaping station toward said tempering station,
   characterised in that it comprises
   a roller conveyor (4) extending horizontally through said furnace for feeding the glass sheet in a downstream direction through said furnace along a predetermined path;
   said shaping station including said bed means in a position immediately adjacent to said roller conveyor and having a supporting surface of flat configuration for supporting the glass sheet at a floating level on said air bed;
   said first glass supporting ring (24) being mounted in said shaping station for vertical movement between a lowered position below said floating level and a raised position closer to said perforated shaping surface of said upper shaping mold (17) relative to said lowered position;
   a second glass supporting ring (34) for supporting the glass sheet;
   ring moving means (16) for moving said second glass supporting ring horizontally from said shaping station toward said tempering station; and
   said air bed means comprise an air plenum (5) and a plurality of upwardly directed air nozzles (7) individually removable supported by said plenum and in fluid communication with said plenum to allow air to be supplied through said nozzles from said plenum to form said air bed, said plenum having a ring-shaped area devoid of said nozzles, said ring shaped area corresponding to a shape of said glass supporting ring (24) to be positioned in said ring-shaped area below said floating level, and said air nozzles (7) being higher than the thickness and/or the radius of curvature of said glass supporting ring (24) to allow said ring to be positioned below said floating level of said air bed.

2. An apparatus as claimed in claim 1, wherein said shaping section further includes a frame (8) supporting said plenum (5), a first end of said frame being mounted on a pair of hinges (9) and a second end of said frame being mounted on mechanical jacks (10) for allowing said plenum and said air bed to be inclined downwardly in said downstream direction.

3. An apparatus as claimed in claim 2, wherein said shaping section further includes a stop means (50) for stopping the glass sheet in a predetermined position on said air bed aligned above said glass support ring (24) when said glass support ring is in said position below said floating level, said stop means comprising a first pair of reference stops (45), each including a cylinder (43) and a rod (44) extending therefrom to contact a front edge of the glass sheet, and a second pair of reference stops (45), each including a cylinder (43) and a rod (48) extending therefrom to contact a side edge of the glass sheet.

4. An apparatus as claimed in claim 1, wherein each of said air nozzles (7) is mounted to said plenum by screw threads (53) and includes an upwardly converging channel (56) in communication with said plenum (5), a first cylindrical portion (57) extending from said upwardly converging channel and having a first predetermined cross section for causing a substantially constant air flow rate, a second cylindrical portion (58) extending from said first cylindrical portion and having a second predetermined cross section larger than said first predetermined cross section, and a final frustoconically shaped portion (60) extending from said second cylindrical portion for reducing the air flow rate and forming a portion of said air bed.

5. An apparatus as claimed in claim 4, wherein each of said air nozzles further includes an upwardly diverging portion between said first and second cylindrical portions.

6. An apparatus as claimed in claim 1, wherein each of said nozzles (7) includes a portion (57) having a cross-sectional diameter of 2 to 8 millimeters.

7. An apparatus as claimed in claim 1, wherein each of said nozzles has an air outlet with a cross-sectional diameter of 40 to 100 millimeters.

8. An apparatus as claimed in claim 1, wherein said air bed means includes a means for supplying air to said air nozzles at a pressure of 50 to 100 millibar.

9. An apparatus as claimed in claim 1, wherein said plenum includes a plurality of threaded nozzle engaging means (52) for removably engaging said plurality of air nozzles and fluidically communicating said nozzles with said plenum.

10. An apparatus as claimed in claim 9, further comprising threaded plugs (61), removably engaged with ones of said threaded nozzle engaging means (52) disposed in said ring-shaped area, for preventing air from escaping from said plenum through said ones of said threaded nozzle engaging means disposed in said ring-shaped area.

11. An apparatus as recited in claim 10, wherein said threaded nozzle engaging means (52) respectively comprise internally threaded bores;

    each of said nozzles includes an externally threaded cylindrical portion (53) engageable in one of said bores; and
    each of said threaded plugs (61) comprises an externally threaded plug engageable in one of said bores.

12. An apparatus as claimed in any one of the preceding claims, characterized in that it comprises

    said shaping station including a pair of air bed means for supporting one or two glass sheets (V) at said floating level on a pair of air beds (63) downstrream of said roller conveyor along said predetermined path;
    a pair of said first glass supporting ring (24) for supporting the glass sheets;
    said plenums (62) being positioned adjacent one another and symmetrically about a vertical axis of symmetry of said shaping station; and
    a vertically mobile strut (64) arranged on said vertical axis of symmetry of said shaping station and supports inner ends of said plenums, outer ends of said plenums being supported on hinges (65), respectively, such that said plenums are capable of inclination in a transverse direction with respect to said predetermined path.

Patentansprüche

1. Vorrichtung zum Formen und Abschrecken einer Glasplatte (V) zur Verwendung in einem Motorfahrzeug, umfassend.

    eine Heizstation, die einen horizontalen Ofen (1) einschließt,

    eine Formungsstation (2), die stromabwärts der genannten Heizstation angeordnet ist und eine Luftbetteinrichtung und eine obere Formungsform (17) einschließt, die eine gelochte Formungsoberfläche und eine Unterdruckeinrichtung zum Erzeugen von Ansaugen durch die genannte gelochte Formungsoberfläche hindurch aufweist, um die Glasplatte daran anzuziehen.

    eine Abschreckstation (3), die stromabwärts der genannten Formungsstation angeordnet ist, und eine Abschreckdüseneinrichtung zum schnellen Abkühlen der Glasplatte einschließt.

    einen ersten Glastragring (24) zum Tragen der Glasplatte, wobei der genannte Glastragring (24) vertikal von einer Lage unterhalb der genannten Luftbetteinrichtung bewegbar ist;

    eine Ringbewegungsvorrichtung (16) zum Bewegen des genannten Glastragrings vertikal in Richtung zu der genannten gelochten Formungsoberfläche der genannten oberen Formungsform und zum Bewegen des genannten Glastragrings horizontal von der genannten Formungsstation in Richtung zu der genannten Abschreckstation,
    dadurch gekennzeichnet, daß sie umfaßt

    einen Walzenförderer (4), der sich horizontal durch den genannten Ofen zum Zuführen der Glasplatte in einer stromabwärtigen Richtung durch den genannten Ofen hindurch entlang einem vorbestimmten Weg erstreckt;

    die genannte Formungsstation die genannte Betteinrichtung in einer Lage unmittelbar dem genannten Walzenförderer benachbart einschließt und eine Tragoberfläche flacher Ausgestaltung zum Tragen der Glasplatte auf einer Schwimmhöhe auf dem genannten Luftbett aufweist;

    der genannte erste Glastragring (24) in der genannten Formungsstation zu vertikalen Bewegung zwischen einer abgesenkten Lage unterhalb der genannten Schwimmhöhe und einer angehobenen Position näher zu der genannten gelochten Formungsoberfläche der

genannten oberen Formungsform (17) relativ zu der genannten abgesenkten Lage angebracht ist;

einen zweiten Glastragring (34) zum Tragen der Glasplatte;

eine Ringbewegungsvorrichtung (16) zum Bewegen des genannten zweiten Glastragrings horizontal von der genannten Formungsstation in Richtung zu der genannten Abschreckstation; und

die genannte Luftbetteinrichtung eine Luftsammelkammer (5) und eine Mehrzahl von aufwärts gerichteten Luftdüsen (7) umfaßt, die einzeln entfernbar von der genannten Sammelkammer und in Fluidverbindung mit der genannten Sammelkammer gehalten sind, damit Luft, die durch die genannten Düsen von der genannten Sammelkammer zuzuführen ist, das genannte Luftbett bildet, die genannte Sammelkammer einen ringförmigen Bereich frei von den genannten Düsen aufweist, der genannte ringförmige Bereich einer Form des genannten Glastragrings (24) entspricht, der in dem genannten ringförmigen Bereich unterhalb der genannten Schwimmhöhe angeordnet werden soll, und die genannten Luftdüsen (7) höher als die Dicke und/oder der Krümmungsradius des genannten Glastragrings (24) sind, damit der genannte Ring unterhalb der genannten Schwimmhöhe des genannten Luftbetts angeordnet werden kann.

2. Eine Vorrichtung, wie in Anspruch 1 beansprucht, worin der genannte Formungsabschnitt ferner einschließt einen Rahmen (8), der die genannte Sammelkammer (5) hält, wobei ein erstes Ende des genannten Rahmens an einem Paar von Gelenken (9) angebracht ist und ein zweites Ende des genannten Rahmens an mechanischen Hebevorrichtungen (10) angebracht ist, damit die genannte Sammelkammer und das genannte Luftbett abwärts in der genannten stromabwärtigen Richtung geneigt werden können.

3. Eine Vorrichtung, wie in Anspruch 2 beansprucht, worin der genannte Formungsabschnitt ferner einschließt eine Anschlageinrichtung (50) zum Anhalten der Glasplatte in einer vorbestimmten Lage auf dem genannten Luftbett, das oberhalb des genannten Glastragrings (24) ausgerichtet ist, wenn der genannte Glastragring in der genannten Lage unterhalb der genannten Schwimmhöhe ist, die genannte Anschlageinrichtung ein erstes Paar von Bezugsanschlägen (45) umfaßt, von denen jeder einen Zylinder (43) und eine Stange (44) einschließt, die sich von dort erstrecken, um eine Vorderkante der Glasplatte zu berühren, und ein zweites Paar von Bezugsanschlägen (45), von denen jeder einen Zylinder (43) und eine Stange (48) einschließt, die sich davon erstreckt, um einen Seitenrand der Glasplatte zu berühren.

4. Eine Vorrichtung, wie in Anspruch 1 beansprucht, worin jede der genannten Luftdüsen (7) an der genannten Sammelkammer durch Schraubengewinde (53) befestigt ist und einen sich aufwärts verjüngenden Kanal (56) in Verbindung mit der genannten Sammelkammer (5), einen ersten zylindrischen Abschnitt (57), der sich von dem genannten sich aufwärts verjüngenden Kanal erstreckt und einen ersten vorbestimmten Querschnitt aufweist, um eine im wesentlichen konstante Luftströmungsgeschwindigkeit hervorzurufen, einen zweiten, zylindrischen Abschnitt (58), der sich von dem genannten ersten, zylindrischen Abschnitt erstreckt und einen zweiten, vorbestimmten Querschnitt größer als der genannte erste, vorbestimmte Querschnitt aufweist und einen kegelstumpfförmigen Endabschnitt (60) einschließt, der sich von dem genannten zweiten, zylindrischen Abschnitt erstreckt, um die Luftströmungsgeschwindigkeit zu verringern und einen Abschnitt des genannten Luftbetts zu bilden.

5. Eine Vorrichtung, wie in Anspruch 4 beansprucht, worin jede der genannten Luftdüsen ferner einen sich aufwärts erweiternden Abschnitt zwischen dem genannten ersten und zweiten zylindrischen Abschnitt einschließt.

6. Eine Vorrichtung, wie in Anspruch 1 beansprucht, worin jede der genannten Düsen (7) einen Abschnitt (57) einschließt, der einen Querschnittsdurchmesser von 2 bis 8 Millimetern aufweist.

7. Eine Vorrichtung, wie in Anspruch 1 beansprucht, worin jede der genannten Düsen einen Luftauslaß mit einem Querschnittsdurchmesser von 40 bis 100 Millimeter aufweist.

8. Eine Vorrichtung, wie in Anspruch 1 beansprucht, worin die genannte Luftbetteinrichtung einer Einrichtung zum Zuführen von Luft zu den genannten Luftdüsen bei einem Druck von 50 bis 100 Millibar einschließt.

9. Eine Vorrichtung, wie in Anspruch 1 beansprucht, worin die genannte Sammelkammer eine Mehrzahl von mit Gewinde versehenen Düseneingriffseinrichtungen (52) zum entfernbaren Eingriff der genannten Mehrzahl von Luftdüsen an der und zum fluidmäßigen Verbinden der genannten Düsen mit der genannten Sammelkammer einschließt.

10. Eine Vorrichtung, wie in Anspruch 9 beansprucht,

die ferner Gewindestopfen (61) umfaßt, die entfernbar mit welchen der genannten mit Gewinde versehenen Düseneingriffseinrichtungen (52) in Eingriff sind, die in den genannten ringförmigen Bereich angeordnet sind, um Luft daran zu hindern, von der genannten Sammelkammer durch die genannten der genannten mit Gewinde versehenen Düseneingriffseinrichtungen zu entweichen, die in dem genannten ringförmigen Bereich angeordnet sind.

11. Eine Vorrichtung, wie in Anspruch 10 angegeben, worin die genannten mit Gewinde versehenen Düseneingriffseinrichtungen (52) jeweils Innengewindebohrungen umfassen;

jede der genannten Düsen einen zylindrischen Außengewindeabschnitt (53) einschließt, der in eine der genannten Bohrungen eingreifbar ist; und

jede der genannten Gewindestopfen (61) einen Stopfen mit Außengewinde umfaßt, der in eine der genannten Bohrungen eingreifbar ist.

12. Eine Vorrichtung, wie in irgendeinem der vorhergehenden Ansprüche beansprucht, **dadurch gekennzeichnet**, daß sie umfaßt

die genannte Formungsstation, die ein Paar Luftbetteinrichtungen zum Tragen von einer oder zwei Glasplatten (V) auf der genannten Schwimmhöhe auf einem Paar von Luftbetten (63) stromabwärts des genannten Walzenförderers zusammen mit dem genannten vorbestimmten Weg einschließt;

ein Paar des genannten ersten Glastragerings (24) zum Tragen der Glasplatten;

die genannten Sammelkammern (62) nahe einander und symmetrisch zu einer vertikalen Symmetrieachse der genannten Formungsstation angeordnet sind; und

eine vertikal bewegbare Strebe (64) auf der genannten vertikalen Symmetrieachse der genannten Formungsstation angeordnet ist und innere Enden der genannten Sammelkammern hält, wobei die äußeren Enden der genannten Sammelkammern an Gelenken (65) jeweils gehalten sind, so daß die genannten Sammelkammern einer Neigung in einer Querrichtung in bezug auf den genannten vorbestimmten Weg fähig sind.

Revendications

1. Dispositif pour le formage et la trempe d'une feuille de verre (V), destinée à l'utilisation dans un véhicule automobile, comprenant

un poste de chauffage comportant un four horizontal (1),
un poste de formage (2), positionné en aval du poste de chauffage comprenant un lit d'air et un moule de formage supérieur (17) avec une surface de formage perforée et des moyens de mise sous vide pour créer l'aspiration à travers la surface de formage perforée pour y attirer la feuille de verre,
un poste de trempe (3) positionné en aval du poste de formage et comprenant un moyen de tuyère de trempe destiné à refroidir rapidement la feuille de verre,
un premier anneau de support de verre (24) pour supporter la feuille de verre, cet anneau de support de verre (24) étant mobile verticalement à partir d'une position située au-dessous du lit d'air ;
des moyens de déplacement d'anneau (16) pour déplacer l'anneau de support de verre verticalement en direction de la surface de formage perforée du moule de formage supérieur et pour déplacer l'anneau de support de verre horizontalement à partir du poste de formage vers le poste de trempe,
caractérisé en ce qu'il comprend
un transporteur à rouleaux (4) s'étendant horizontalement à travers le four pour amener la feuille de verre vers l'aval à travers le four le long d'un circuit prédéterminé,
le poste de formage comprenant un lit dans une position immédiatement contiguë au transporteur à rouleaux et ayant une surface de support de configuration plate pour recevoir la feuille de verre à un niveau de flottement sur le lit d'air ;
le premier anneau de support de feuille de verre (24) étant monté dans le poste de formage pour le mouvement vertical entre une position abaissée au-dessous du niveau de flottement et une position relevée plus proche de la surface de formage perforée du moule de formage supérieur (17) par rapport à la position abaissée ;
un second anneau supportant le verre (34) pour supporter la feuille de verre ;
des moyens de déplacement d'anneau (16) pour déplacer le second anneau supportant le verre horizontalement à partir du poste de formage vers le poste de trempe ; et
le lit d'air comprend un collecteur d'air (5) et plusieurs tuyères d'air dirigées vers le haut (7) supportées de façon individuellement amovible par le collecteur d'air et en communication de fluide avec le collecteur d'air pour permettre l'alimentation d'air à travers les tuyères à partir de ce collecteur d'air et pour former le lit d'air,

ce collecteur d'air ayant une surface annulaire exempte de tuyères, cette surface annulaire correspondant à une forme d'anneau supportant le verre (24) à positionner dans la surface annulaire au-dessous du niveau de flottement et les tuyéres d'air (7) étant à un niveau supérieur à l'épaisseur et/ou aux rayons de courbe de l'anneau de support de verre (24) pour permettre le positionnement de cet anneau au-dessous du niveau de flottement du lit d'air.

2. Appareil selon la revendication 1, dans lequel la section de formage comprend de plus un châssis (8) supportant le collecteur d'air (5), une première extrémité du châssis étant montée sur une paire d'articulations (9) et une seconde extrémité du châssis étant montée sur des vérins mécaniques (10) permettant l'inclinaison vers le bas du collecteur d'air et du lit d'air vers l'aval.

3. Appareil selon la revendication 2, dans lequel la section de formage comprend de plus des moyens d'arrêt (50) pour immobiliser la feuille de verre dans une position prédéterminée sur le lit d'air aligné au-dessus de l'anneau de support de verre (24) lorsque l'anneau de support de verre se trouve dans la position au-dessous du niveau de flottement, ces moyens d'arrêt comprenant une première paire de butées de référence (45), chaque butée incorporant un vérin (43) et une tige (44) s'étendant à partir de celui-ci pour venir en contact avec le bord frontal de la feuille de verre et une seconde paire de butées de référence (45), chaque butée comprenant un vérin (43) et une tige (48) s'étendant à partir de celui-ci pour venir en contact avec le bord latéral de la feuille de verre.

4. Appareil selon la revendication 1, dans lequel chacune des tuyères d'air (7) est montée sur le collecteur d'air par vissage (53) et comprend un canal convergeant vers le haut (56) en communication avec le collecteur d'air (5), une première portion cylindrique (57) s'étendant à partir du canal convergeant vers le haut et présentant une section transversale prédéterminée pour assurer un débit d'air sensiblement constant, une seconde portion cylindrique (58) s'étendant à partir de la première portion cylindrique ayant une seconde section transversale prédéterminée plus grande que la première section transversale prédéterminée et une portion tronconique finale (60) s'étendant à partir de la seconde portion cylindrique pour réduire le débit d'air et formant une portion du lit d'air.

5. Appareil selon la revendication 4, dans lequel chacune des tuyères d'air comprend de plus une portion divergeant vers le haut entre les première et seconde portions cylindriques.

6. Appareil selon la revendication 1, dans lequel chaque tuyère (7) comprend une portion (57) avec un diamètre de section transversale de 2 à 8 millimètres.

7. Appareil selon la revendication 1, dans lequel chaque tuyère présente une sortie d'air ayant un diamètre de section transversale de 40 à 100 millimètres.

8. Appareil selon la revendication 1, dans lequel le lit d'air comprend des moyens pour amener l'air aux tuyères d'air à une pression de 50 à 100 millibars.

9. Appareil selon la revendication 1, dans lequel le collecteur d'air comprend plusieurs moyens d'engagement filetés (52) pour les tuyères permettant de monter par vissage la pluralité de tuyères d'air de façon amovible et mettre en communication le fluide de celles-ci avec le collecteur d'air.

10. Appareil selon la revendication 9, comprenant de plus des bouchons filetés (61), engagés de façon amovible avec des moyens d'engagement filetés (52) des tuyères disposés dans la surface annulaire pour empêcher l'air de s'échapper du collecteur par certains des moyens d'engagement filetés des tuyères disposés dans la zone annulaire.

11. Appareil selon la revendication 10, dans lequel les moyens d'engagement filetés (52) des tuyères comprennent respectivement des alésages filetés à l'intérieur ;

chaque tuyère comprend une portion cylindrique filetée à l'extérieur (53) pouvant s'engager dans l'un des alésages ; et
chaque bouchon fileté (61) comprend un bouchon fileté extérieurement pouvant s'engager dans l'un des alésages.

12. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend

le poste de formage comprenant une paire de lits d'air pour supporter une ou deux feuilles de verre (V) au niveau de flottement sur une paire de lits d'air (63) en aval du transporteur à rouleaux le long d'un circuit prédéterminé ;
une paire de premiers anneaux de support de verre (24) pour supporter les feuilles de verre ;
les collecteurs d'air (62) étant positionnés de façon contiguë entre eux et symétriquement autour d'un axe vertical de symétrie du poste de formage ; et
un longeron mobile verticalement (64) disposé sur l'axe vertical de symétrie du poste de formage et qui supporte les extrémités internes des collecteurs d'air, les extrémités extérieures

des collecteurs d'air étant respectivement montées sur des articulations (65) de telle sorte que les collecteurs d'air peuvent être inclinés dans une direction transversale par rapport au circuit prédéterminé.

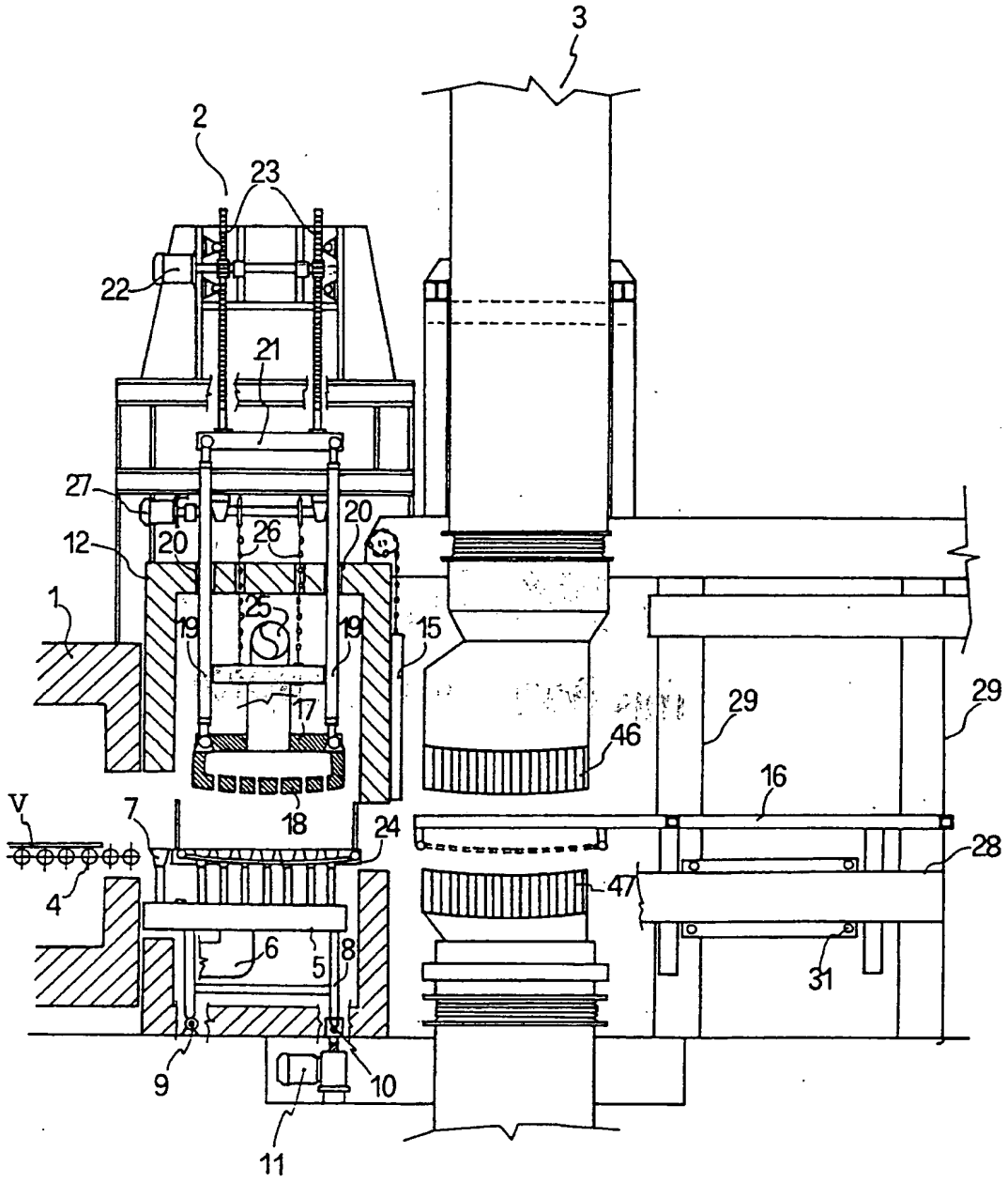
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FIG 1

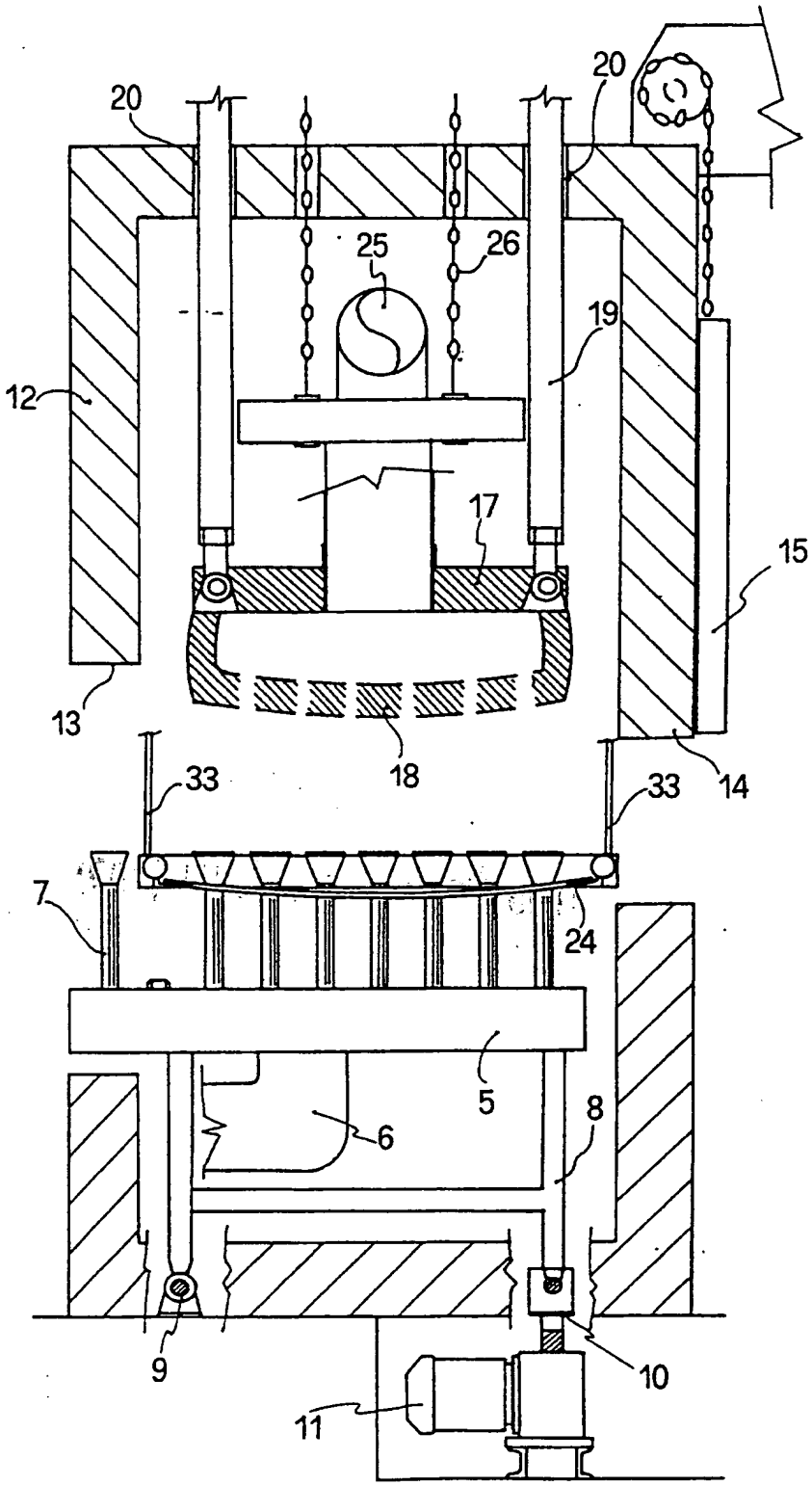

FIG 2

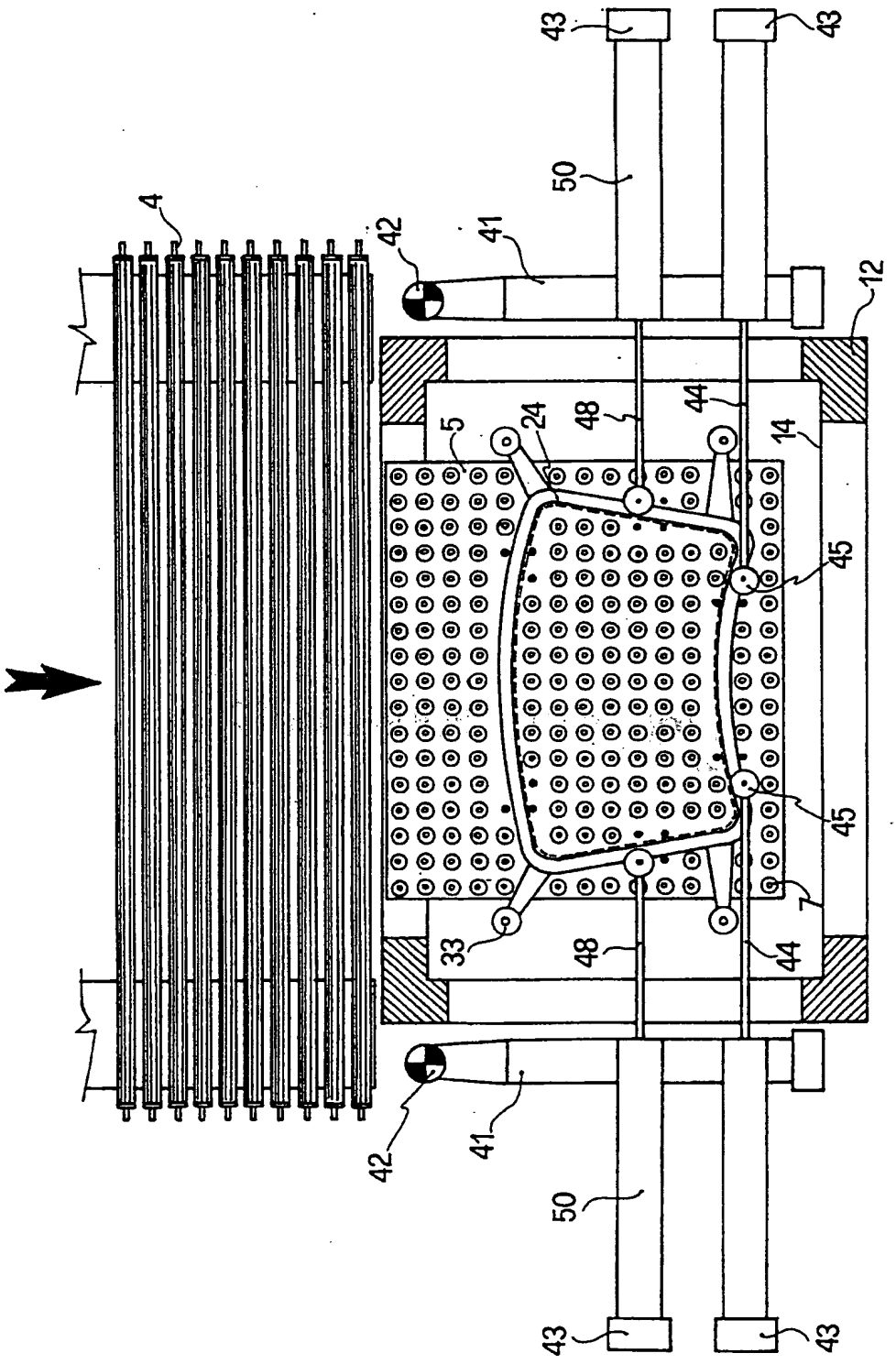

FIG 3

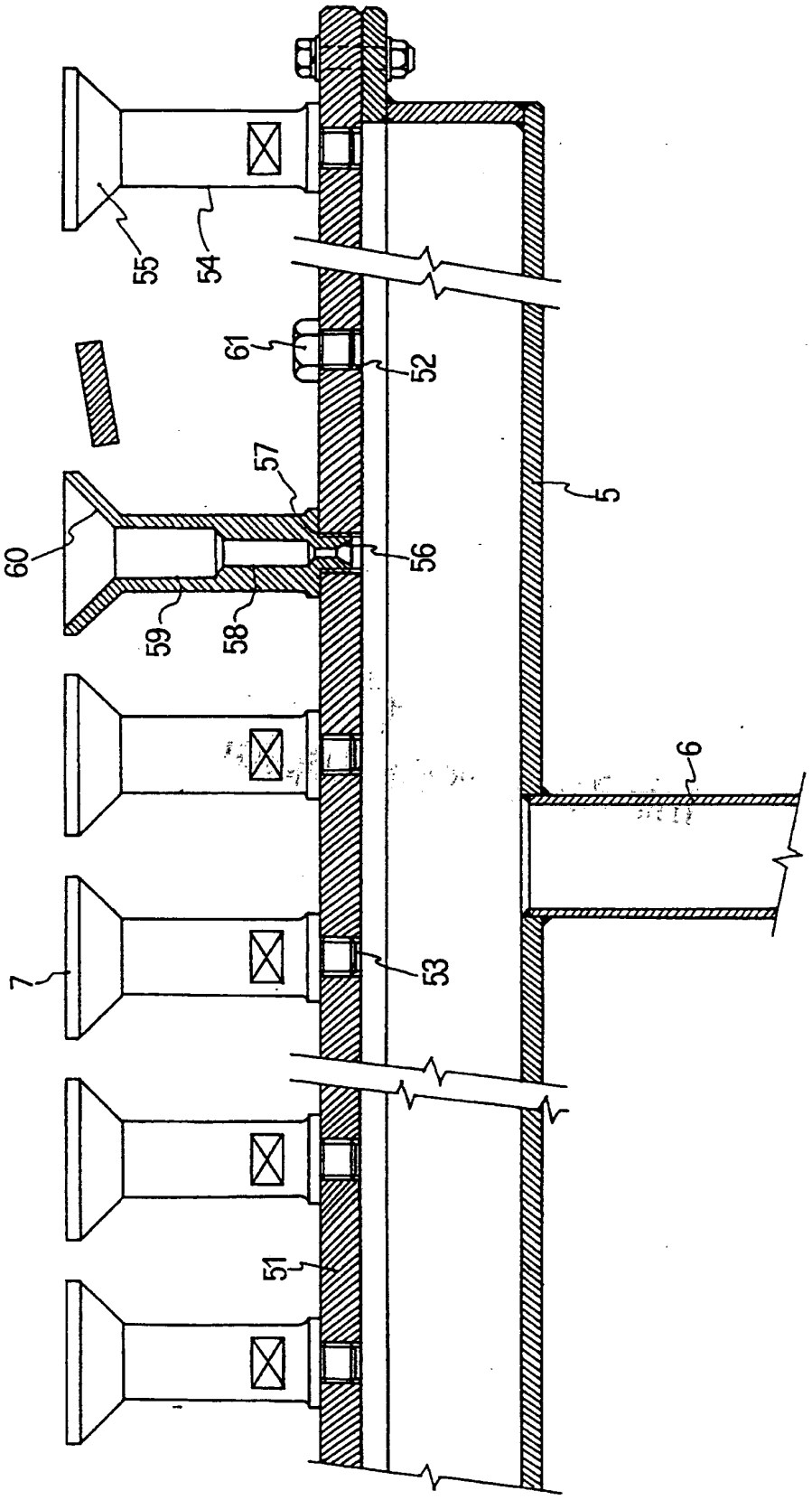

FIG 4

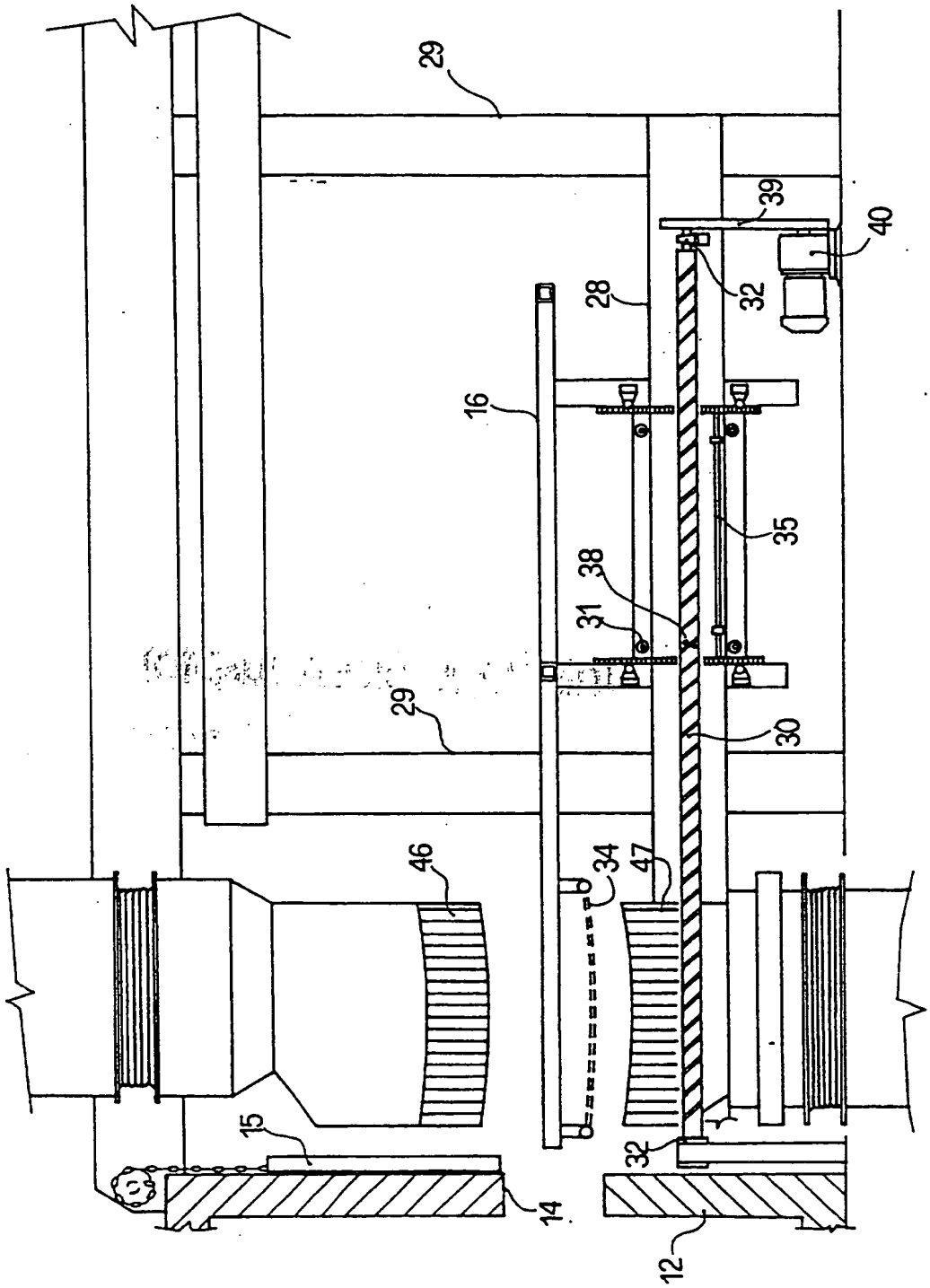

FIG 5

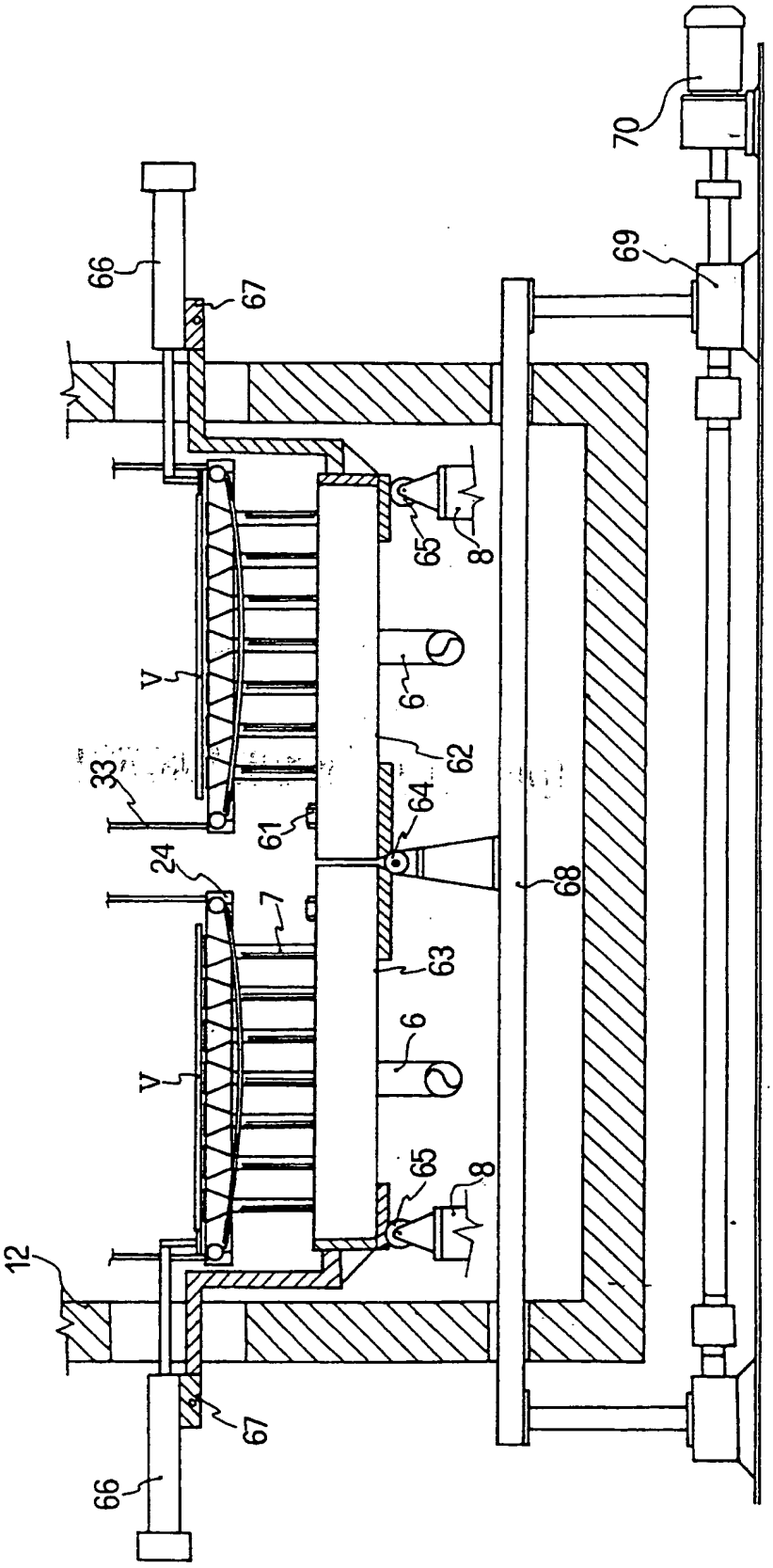

FIG 6